THE

ELECTRICAL REVIEW.

VOL. XLIX. DECEMBER 20, 1901. No. 1,256.

CONTENTS:

	PAGE
Overhead Telegraphs and the Storm	1029
Comparison of Storage Battery Traction and the Overhead Trolley	1031
Stewart Engine for Dublin Corporation (*illustrated*) ...	1032
Belliss Engines for Electric Traction (*illustrated*)	1033
Legal	1033
Correspondence:—	
Municipal Competition	1037
A Question of Etiquette	1037
Drop Forging...	1037
Accumulator and Electric Traction Systems (*illustrated*)	1037
Brakes	1038
The Crawford-Voelker Lamp	1038
Batteries and Boosters for Electric Traction	1039
Mixed	1039
Cable *v.* Electric Traction	1040
Business Notes	1040
Sprague Multiple Unit System (*illustrated*) (*continued*) ...	1045
The Central Exchange of the London Post Office Telephones (*illustrated*) (*continued*)	1047
City Notes	1053
Traffic Receipts	1056
Stocks and Shares	10 6
Share List of Electrical Companies	1057
Market Quotations	1058
Institution of Electrical Engineers:—	
A Permeameter for Testing the Magnetic Qualities of Materials in Bulk (*illustrated*)	1059
Current Specifications.—LXXXIV.	1060
Shallow Underground Tramways	1061
The Armstrong-Orling System of Wireless Telegraphy (*illus.*)	1061
New Patents	1063
Abstracts of Published Specifications	1064

THE

UNIVERSAL ELECTRICAL DIRECTORY

1902 Edition

NOW IN PREPARATION.

NEW MATTER AND CORRECTIONS SHOULD BE SENT IN AT ONCE.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.
Telephone No. 933 Holborn.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, AND HAS

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—In Great Britain, Post Free per Year, 19s. 6d. To all other countries, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can now be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. Paris: VEUVE J. BOYVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13 Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

OVERHEAD TELEGRAPHS AND THE STORM.

THE disastrous storm of the 12th inst. constitutes this winter's contribution, or part of it, to the evidence available for considering the efficacy, or otherwise, of present practice in overhead telegraph construction. The widespread destruction of telegraph lines by the recent storm, and also that of February of last year, emphasises the great need for such consideration, and will, no doubt, give rise to the usual cry for underground lines. Granting the feasibility of such lines for the public telegraphs, it would, however, be a very long time before they could be completed; and in the case of private lines such as are used by railway companies, and which are quite as important to the public, it is a question whether the expense of such re-construction would not be altogether prohibitive.

The public telegraph has so woven itself into the life of the country as to become an absolute necessity, and general breakdown leads to complete disorganisation of business, and consequent loss to the community, whilst the breakdown of private telegraphs such as those used by railway companies for their various purposes involves delay and no little risk to the travelling public, and incalculable loss to the companies by the disorganisation of their services. It is only at such times as the present that the value of the telegraph as a means of ensuring the safety and despatch of railway traffic is fully realised. The time has now gone by when such periodical breakdowns could be condoned by those who had put up with the inconvenience of the old methods of intercommunication. The business man of any class now looks for his necessities being supplied without fail, and he expects that such contracts as are implied by the taking of his money on certain understandings for the transmission of intelligence, or the transport of himself or his goods, shall be carried out within the lines of the agreements, by which he himself is bound. Hence the essential point is continuity of service under all circumstances, and such continuity can only be ensured during storms by construction designed to meet the worst cases previously experienced, and, what is perhaps of greater importance, by careful maintenance. Poles, stays, wires, and insulators must be kept in sound condition if breakdown is to be avoided. From the moment a line is erected it begins to deteriorate, and the margin of safety to meet abnormal stresses decreases. To leave a pole to stand until, as the old gibe runs, the earth wire alone keeps it up, and the wires, until they announce their condition by breaking under normal circumstances, is to invite disaster.

In a paper read at the Institution of Electrical Engineers on April 30th, 1896, Mr. Langdon, under the head of "Staying," said:—

"It is no exaggeration to say that to the perfect manner

of staying the telegraph lines of the present day . . . . are we indebted for that greater immunity from heavy breakdown we enjoy at the present. It is, in cases of snow, falling under those conditions which cause it to cling to the wires, a question of strength of pole *versus* strength of wire. Needless to say, it is preferable that the wires rather than the poles should suffer; and as a rule, such is the *status* at which well-built telegraph lines of the present day have arrived."

The conclusion that it is preferable for the wires to be damaged, rather than the poles, is understandable from the point of view of those who have to repair them, inasmuch as such repairs are more easily effected when the poles remain intact; but from the point of view of those who have to use the wires, and depend upon them for the arrangement of the details of their business, or for expediting their work, it matters little whether the poles or the wires have been the cause of the failure, so long as the apparatus is not available for the purposes for which it is provided. Moreover, in anything like a general breakdown, destruction of the wires is always accompanied more or less by breakage or displacement of the poles.

The point of view of the user, who cares nothing about the engineering details, but who insists upon the lines being available whenever required, is the objective to be aimed at in the construction of telegraph lines, as in other engineering work. A strong pole line is of little use for ensuring continuity of service unless backed by wire of corresponding strength. The function of the pole and its accessories is to support the wires under all conditions less than the breaking stress of the latter. The wires may be broken by the weight of snow and ice accumulated on them, assisted by the effects of contraction and a heavy gale; or the poles may be blown down, whilst the wires remain intact. In neither case, however, it should be noted, is the strength of the pole line helpful to the wires, or *vice versâ*. Each part must stand alone the stresses to which it is subject. The mechanical strength of each part must be such as to withstand the stresses peculiar to it, in so far as the maximum stresses can be estimated. If the poles successfully withstand such stresses and the wires do not, or *vice versâ*, the component parts of the line are not properly proportioned at the time, and the lesson of the Deacon's one-horse shay requires to be re-learned.

It may, of course, be argued with perfect propriety that the component parts of a line do not deteriorate uniformly. This, however, is a question of maintenance, solely. It is true, also, that the maintenance is a matter in which financial considerations are involved. But this again is simply an equation in which the factors are the cost of such maintenance, on the one side, and the losses due to extensive breakdown on the other. Such losses are difficult to estimate in their entirety. From the owner's point of view they are large in the actual cost of replacement and loss of earnings, but the loss to the user and those more indirectly affected is probably greater still, to say nothing of the worry and uncertainty entailed.

The stresses to which a line will be subject are easily calculated if the maximum effects can be estimated, but it is a question whether much of the work is not done by rule of thumb. The Post Office engineers have, of course, given very considerable attention to the subject, and Sir W. H. Preece's British Association paper is the classic on overhead telegraph construction. It is, however, to be feared that an estimated maximum wind pressure of $18\frac{3}{4}$ lbs. per sq. ft. of exposed surface, and a factor of safety of 4 for new work, are both too small. Wind pressures of 30 lbs. per sq. ft. and over have been registered in this country, and when wires are covered with ice or frozen snow to diameters from 15 to 20 times the normal, the accumulated effects of the additional weight, increased surface to great wind pressure, and the momentum acquired by the swinging wires, are sufficient to raise the stresses perilously near the breaking point for new iron wire of No. 8 or $7\frac{1}{2}$ gauge, to say nothing of the smaller iron or copper wires used.

The factor of safety for the tensile stress on the wires is a most important point in view of the fact that hitherto the mechanical strength of wire for telegraphic purposes has been subordinated to its electrical properties. Given a factor of safety of 4 for new iron wire, at erection, how long will that factor be maintained? Iron wires decay rapidly (galvanising being a very temporary protection in most cases), and the decay is not so uniform as to ensure a diminution of weight in proportion with the reduced sectional area. In other words, the wire "pits," and its strength is lowered thereby, far below that which might be assumed from gauging the wire, or even from the measurement of the conductor resistance. Another point to which but slight attention has been given hitherto is the change in the character of the wire which takes place after it has been suspended under tension for some time, and which is probably due to some extent to the constant vibration to which the wire is subject. No one who has had experience with wire taken down after prolonged suspension can have failed to note its hard "short" character, compared with new wire, and this results in the loss of that elasticity which is so greatly relied upon to meet abnormal stresses.

All this, of course, and the fact that nowadays the wires deteriorate much more rapidly than the supports, points to a reduction of the tensile stress on the wires being most desirable. For the spans ordinarily in use in this country reduction of the erecting stress would probably result in greater dip than is desirable from the point of view of freedom from line faults. Hence the only practical method is to reduce the spans, by which the factor of safety of the wires might be considerably increased and the present dips retained. That spans are too long at present is patent to anyone who will notice them. On road lines the multiplication of wires has necessitated the crowding of the wires near the top of the pole in order to obviate the use of longer poles. On such lines adequate staying is difficult owing to want of room, but in many cases no change seems to have been made in the spans in order to obtain greater stiffness of the line, and thus to compensate for the greater effect of wind pressure at right angles to the line. On some railways the observer may see considerable sections of line which have been re-poled with practically the same spans as the lines of the old telegraph companies which previously occupied the routes, and even poles originally erected by those companies are still in use.

Stronger pole lines, in the sense of a greater number of poles per mile, with consequently less tensile stress on the wires,

together with careful maintenance and renewal of the wires before decay gets too far, will go a long way to prevent such occurrences as have recently taken place. The resources of engineering are not so nearly used up as to make such widespread breakdown inevitable. Much has been done of recent years to increase the stability of telegraph lines, but the recurrence of such disasters and general observation show that much remains to be done. It is not yet necessary that "something has to give way to let it (the storm) through"—a remark ascribed by a representative of a daily paper to a "chief official" *à propos* of the recent storm.

Wireless Telegraphy across the Atlantic.

THE latest feat of Marconi is so sensational that we are inclined for the present to think that his enthusiasm has got the better of his scientific caution. Marconi has cabled from Newfoundland that he has received signals on several different occasions from the Marconi station at the Lizard, Cornwall. The signal received was the Morse letter S, which consists of three dots. Marconi had arranged with the Cornwall station that the letter S was to be signalled a number of times at 6 p.m., and the signals were received in Newfoundland at the time arranged. The vertical conductor at the receiving station, according to one account, was a wire suspended at a height of 400 ft. by a kite; the height of the ærial conductor at the transmitter is not stated. It has been suggested by Sir William Preece that the signals are due to discharges of atmospheric electricity, which usually print the letter S on a Morse instrument. But Marconi must have a wider experience of the effects of atmospheric discharges on his instrument than any man living, and he is not likely to mistake such disturbances for a genuine signal. A more probable explanation is that the signals came from some station in America. A practical joker who had learned when the signals were expected, might easily have fulfilled the expectations of the watchers at the Newfoundland station. Expensive shafts have been sunk in search of coal before now, merely because a mischievous youth had emptied a scuttlefull of coal over-night into the experimental boring. We hope our theory may be incorrect; for if anybody should be the first to telegraph by electric waves across the Atlantic it ought to be Marconi. But we remember Tesla's celebrated message from Mars. One! Two!! Three!!!

Magnalium.—Diegel has recently published in a German paper an investigation of the mechanical properties of this alloy. Magnalium works better than aluminium with all cutting tools, including files; but the difference in behaviour is not greatly marked until the proportion of magnesium reaches 14 per cent. Magnalium can only be hammered in the cold if it contains 14 per cent. or less of magnesium. More of the latter makes the alloy brittle, and it breaks under the hammer. With 6 per cent. or less of magnesium, the strength of magnalium can be notably increased by rolling or working in the cold state. With more than 6 per cent. of magnesium, the alloy will not bear hammering when hot. With 2 to 4 per cent. of magnesium, however, it can be forged at a temperature of 400° C., just like copper at a red heat. At a dull red heat magnalium separates into its constituents; at a little lower temperature it is brittle. At 570° C. magnalium begins to soften, and at 626° C. it is completely liquid. Diegel states distinctly that magnalium cannot be soldered with a soft solder containing tin in the usual way. From his own experiments, Diegel finds that magnalium is readily destroyed by salt water, and therefore the alloy is not at all likely to be useful in ship or marine engine building.

COMPARISON OF STORAGE BATTERY TRACTION AND THE OVERHEAD TROLLEY.*

By E. R. GILBERT, General Manager Chicago Electric Traction Company.

ABOUT five years ago the Englewood and Chicago Electric Street Railway (now operated by the Chicago Electric Traction Company) was built in order to exploit the storage battery system of traction for street railways. Its promoters were interested in the storage battery, and were convinced that in order to make a successful test of its usefulness in connection with street railway work, it would be necessary to equip and operate a complete road, rather than to attempt tests on roads already being operated by means of other systems. Therefore the road was built with every convenience for handling the batteries, and with every possible device for making a successful showing.

The road, at that time, consisted of about 12 miles of track, extending from 63rd Street, Chicago, to Blue Island, Ill., with a branch line of about 2 miles running into Morgan Park, Ill. The power station, where the batteries were charged, was located at 88th Street, which is about half-way between 63rd Street and Blue Island. The road was comparatively level, excepting a grade of 9½ per cent. on the Morgan Park branch. Afterwards the road was extended about 5 miles south of Blue Island to Harvey, Ill., with a branch line ¾ mile long from Blue Island to Calumet Grove.

It was principally on account of the difficulty in operating these branch lines economically that it was finally decided to change the road over to trolley, as under the battery system it was necessary to run cars on these lines to the power station every trip for a charge, thus wasting a considerable mileage.

Although it is not the intention to give a technical description of the entire plant in this article, a limited description of the methods employed in charging the batteries, and some figures concerning the mileage made by them, &c., will doubtless be of interest, and will, perhaps, make it more clear to the reader why the change to trolley was made.

The batteries, which consisted of 72 cells each, were made up of Electric Storage Battery Company's No. 9 T plates, five positive and four negative plates composing each cell. These batteries were set in trays, which were swung in under the centre of the car trucks, and were removed from the cars for charging, by means of a type of sidewalk elevator. The batteries complete weighed 3½ tons each.

Several methods of charging batteries were tried. The first, and the one for which the station was originally designed, was a system of using three separate voltages in the charging room. The batteries, as they were taken from the cars, were placed in a row in the battery room, and the charge was commenced at 165 volts. After the charging current dropped to 20 amperes, the battery was placed on the second bar, having a voltage of 175. When the number of amperes again dropped to 20, it was thrown on to the third bus bar, with 185 volts, where the charge was completed. The batteries were placed in charge and taken out of charge in rotation. This system required a great deal of attention on the part of the battery men, as the voltage and current of each separate battery had to be looked after.

The method which was finally adopted was to charge the batteries in groups. Each group consisted of enough batteries to give a full load to one of the station generators. The charge was started at 165 volts. The station generators, being shunt wound, allowed the voltage to increase as the current dropped until it reached 185, at which point the batteries had become fully charged. This was by far the most successful and economical method tried. At no time would the number of amperes run over 100, and the time for each charge amounted to about the length of time the battery had been used on the road.

In this class of work the best results will be obtained by following the rule of charging batteries at a little higher rate

* *Street Railway Review*, Chicago.

than the rate of discharge, and for the same length of time the battery is used on the road. Both operating expenses and depreciation will be reduced to a minimum by using this method.

A few figures from the battery records while this system was in use will doubtless be of interest. The greatest number of car-miles run by any one battery, composed of entirely new plates, was 27,449·6, and the average mileage of 62 batteries was 23,125·1 miles.

Since the date of the writer's previous article in the *Street Railway Review* (July. 1898), on "Storage Battery Railroading," battery depreciation increased to a considerable extent, principally owing to the fact that it was found that one set of negative plates would outlast two sets of positives. The work of putting in the new positives and the natural increase in the cost of caring for the batteries owing to the old negatives, gradually brought the cost of depreciation up until it averaged 2·276 cents per car-mile.

On account of the distance from Harvey to the power station, it was decided to build a charging sub-station there. This plant was intended only to partly charge batteries, as they would not be fully discharged when reaching this point. The distance of this sub-station from the main station was about 11 miles. A 40-KW. generator and a 50-H.P. gas engine were installed.

This was not an economical plant, but was the only available means for operation to Harvey by the storage battery system. It added an average of $400 per month to operating expenses, which was a large item when it is taken into consideration that but 11 cars were being operated at this time.

From a mechanical point of view everything ran successfully and smoothly, but expenses were so heavy that it was thought best to make the change to trolley, thus avoiding the operation of sub-stations, and the necessity of running all cars on branch lines to the charging station. It would also allow the economical operation of other contemplated branches and extensions which were out of the question while using batteries. During the last year the change was made, and the overhead trolley system was installed, and it has been in operation for several months.

The following figures show the difference in operating cost of the two systems. July, 1899, has been taken to illustrate the storage battery, and July, 1901, the trolley system, these being the most economical months of operation under both methods. The result is most decidedly in favour of the trolley system. It must be remarked, however, that some allowance for the battery system must be made, as the car mileage was greater in 1901 than in 1899. On the other hand, the trolley cars are equipped with two 35-H.P. motors each, while the battery cars carried one 50-H.P. motor.

The comparison of power station expenses is interesting, as it shows so much difference in the cost of operating under a variable load in the case of trolley, and a constant load in the case of storage batteries.

Operating Expenses for One Month.

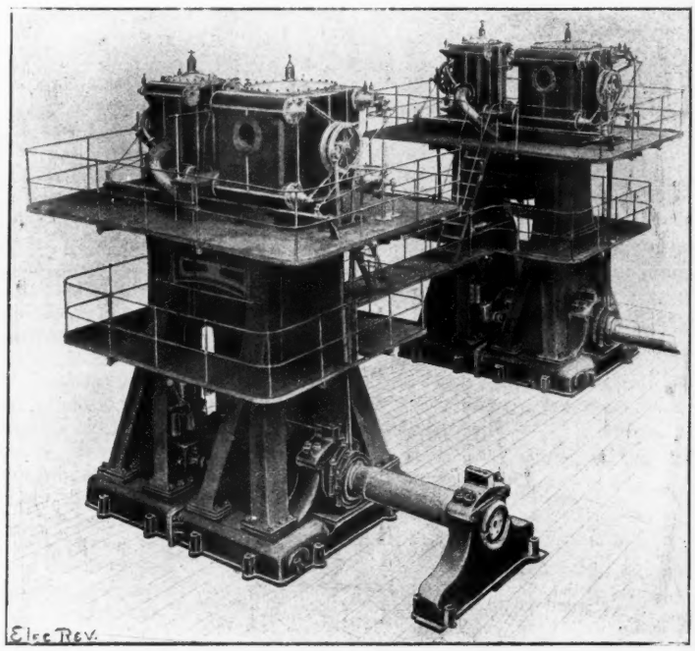
	Storage battery.	Overhead trolley.
Car-miles	78,676·5	98,340·7
Car-days	542	602
Total expense per car-day ...	$16.224	$11.886
Total expense per car-mile ...	·11176	·0736
Total power station expense ...	$1,171.79	$1,659.84
Total KW.-hours	125,487·930	114 801·000
KW.-hours per car-mile	1·59	1·167
Pounds coal consumed	1,080,000	1,336,000
Pounds coal per KW.-hour ...	8·606	11·6375
Power station expense per car-mile	$.0149	$.0168

The writer is of the opinion that there is to-day no better, cheaper, or more satisfactory system of street railway traction, with the exception of overhead trolley, than storage batteries, provided that the charging stations are at the ends of lines, that no more than 10 miles are run upon one charge, that there are no grades of over 4 per cent., and that the number of cars run from each charging station is at least 20.

STEWART ENGINES FOR DUBLIN CORPORATION.

We illustrate herewith two engines which have been built by Messrs. D. Stewart & Co., Limited, of London Road Iron Works, Glasgow, for the Corporation of Dublin.

The engines illustrated are each of 810 I.H.P., and are designed to drive alternating current generators in parallel, each having an output of 500 KW. at normal load. The company are also making two engines of double the above output for the same Corporation, and the four engines will be erected in the new electric lighting station at present in course of construction at Pigeon House Fort, Dublin. As will be seen from the illustration, the engines are of the side-by-side vertical compound Corliss type; the cylinders are 21 in. and 43 in. diameter × 42 in. stroke, and are designed to develop their normal power when running at 94 revolutions per minute, with steam at a pressure of 150 lbs. by gauge and superheated 100° F.,



Stewart Engines for Dublin.

the vacuum being about 27 in. The engines have between the cylinders a vertical re-heater receiver, fitted with steel tubes, through which the steam passes in its course from the high pressure to the low pressure cylinder, steam of boiler pressure being admitted outside the tubes. Both high and low pressure cylinders are fitted with steam jackets, and attention has been paid to the adequate draining of these. The valve gear is of the Reynolds-Corliss type, driven direct from wrist plates situated on the outer end of each cylinder, and actuated from the eccentrics on the crankshaft below. The governors are of the high speed Porter type, with special adjustments for varying the permanent speed to bring the alternators into step. This governor also actuates an emergency valve, should the speed rise above a certain predetermined limit. The end of the engine next the generator is completely enclosed, and the lubrication on all moving parts is accomplished by leading pipes from large

oil boxes, situated on the cylinders, to smaller boxes placed on the main bearings and other rotating and reciprocating parts. The oil is circulated from these upper boxes to the lower ones and raised again by means of a small rotary pump.

The generators are to be of the fly-wheel alternator type, and the fly-wheels, which are also made by Messrs. Stewart and Co., are 15 ft. diameter, and weigh without the coils 30 tons each. The coils and other electrical portions are being made by the Oerlikon Company, of Switzerland, and the whole plant is being supplied to the Dublin Corporation through the medium of the General Electric Company (1900), Limited, of London and Manchester, under the supervision of the consulting engineer for the Dublin Corporation, Mr. Robert Hammond, of Westminster.

BELLISS ENGINES FOR ELECTRIC TRACTION.

Through our having to proceed early to press with our last issue, our notice of the well-known engines made by Messrs. Belliss and Morcom, Limited, of Ledsam Street Works, Birmingham, had unfortunately to be held over. The illustrations which we give below show types and combinations of their engines coupled to two-pole and multipolar continuous current dynamos for traction and power work. The two-crank compound type is a favourite one for initial work, and as the schemes extend, their triple-expansion three-crank three-cylinder engine is put in for bigger units. Fig. 1 shows one of several Belliss-Crompton 120-kw. sets supplied for West Hartlepool. A Belliss-Bruce Peebles combined 250-kw. traction set was lately at work at the Glasgow Exhibition supplying power to the various motors. We may here say that it was always ready to take up any work at any time, and we believe the authorities depended on this plant in many instances to carry them over a tight time. Fig. 2 is an illustration of one of three sets supplied by the firm 12 months ago to the Halifax Corporation, and consists of a Belliss-E.C.C. combined traction plant. With these larger sets no combination baseplate is provided, each machine being bolted direct on to the foundation as shown. During the last 12 or 18 months, about 20 sets of this size have been supplied for central stations at Halifax, Leeds, Glasgow, Southport, Charing Cross and Strand and City Companies, Croydon, Hackney, Calcutta, &c. We have received from the makers a diagram which was taken on test of one of the six 250-kw. Belliss-Siemens sets put down by them at the Waterloo and City Electric Railway. Fuller details of the governing are given in the table in the next column which has been furnished to us.

The value of the Belliss patent system of forced lubrication, combined with the special care taken in the manufacture of their engines and the high-class workmanship and materials used in their construction, are well recognised among English electrical engineers.

Waterloo and City (London) Electric Railway.

Half-minute governor readings.

No. 1 Engine 639 d.e.		No. 3 Engine 641 d.e.		No. 4 Engine 642 d.e.	
Date, May 22nd, 1899. Time, 1.11 p.m. to 1.21 p.m. Mean boiler steam, 160 lbs. Mean volts, 515 Tach. 384·5, actual 388		Date, May 24th, 1899 Time, 11.50 a.m. to 12 noon Mean boiler steam, 170 lbs. Mean volts, 512 Tach. 388, actual 385		Date, May 24th, 1899. Time, 8.14 a.m. to 8.24 a.m. Mean boiler steam, 155 lbs. Mean volts, 520 Tach. 381, actual 391·5	
Amps.	(Tach.) Speed.	Amps.	(Tach.) Speed.	Amps.	(Tach.) Speed.
300	381	95	387	60	380
310	381	95	387	180	378
330	380·5	60	387·5	165	379
80	383·5	110	386	180	378·5
50	384	150	385	190	378
85	383	250	384	200	377·5
50	384	255	384	130	380
50	384	265	384	75	380
150	382	165	385	140	378
130	382·5	200	386	60	380
145	382	240	385	80	380
110	382·5	110	387	85	379
110	382	100	387	220	376
165	381	60	387·5	180	378
210	381	60	387·5	170	378·5
265	380	110	386	210	377
300	380·5	230	386	230	377
312	380·5	120	386·5	255	376·5
330	380	70	387·5	280	376
140	383	50	387·5	110	379
70	384	50	387	200	378

Readings Taken at Various Times.

All load off, 384·5 370 amps., 380·5 Max. run up, 385 Min. run down, 380	All load off, 388 400 amps., 384 Max. run up, 388 Min. run down, 383	All load off, 381 365 amps., 375 Max. run up, 381 Min. run down, 375

Note.—Deviation from mean speed less than ½ per cent. for any variation of load under actual working conditions.

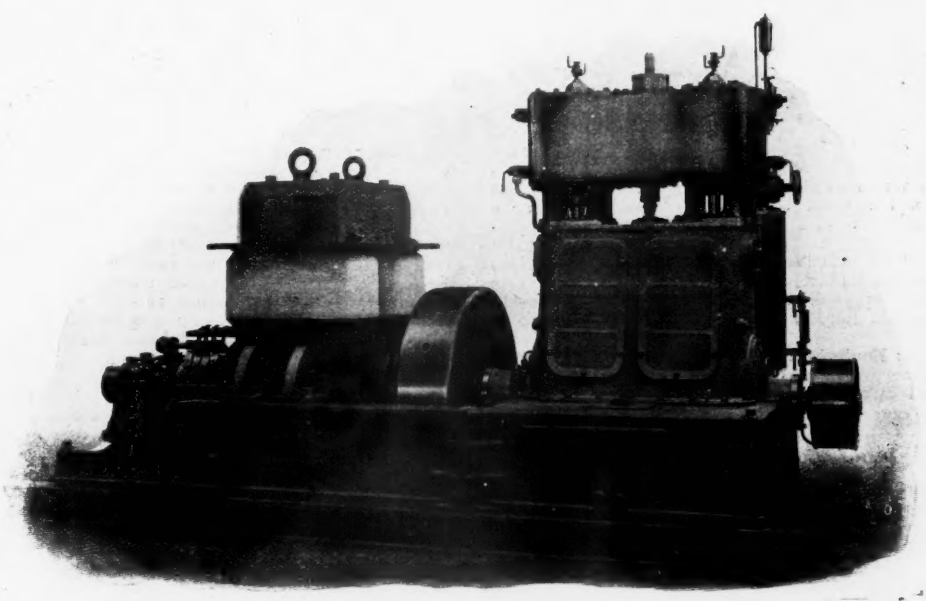


Fig. 1.—120 kw. Belliss-Crompton Set.

LEGAL.

Chamberlain & Hookham, Limited, v. the Mayor, Aldermen and Burgesses of the Borough of Bradford.

(*Continued from page* 923.)

Mr. Astbury, resuming his speech on the 23rd ult., said the previous day he had tried to enumerate what he suggested were the

four essentials of this class of meter, in which a motor was pitted against a magnetic brake. He suggested that one of the points was that they must have slow running to get the range, and Lord Justice Romer asked how did that differ from the fact of using a magnetic brake. The question was one involving a little difficulty. According to Uppenborn, their object was to make one thing great so that friction might be masked, and the instrument would be able to work notwithstanding friction. That was entirely consistent with high speeds for this reason. First, masking or getting rid of friction depended entirely and alone on the driving—it was nothing to do with the brake. The second thing was that they must have a large energy consumption, that was, make as much as possible of the energy consumption of the disc. He did not suggest that the magnet must be made strong. Probably at this date it would be read as meaning exactly the opposite.

Mr. Bousfield said his friend was going away from the evidence.

Lord Justice Williams: Let us assume that you will correct that presently.

Mr. Astbury, continuing, said that nobody denied that the energy consumption of the Faraday disc meant that they must have as much loss of energy created by this disc as possible. When they got a disc between a magnet they got those little eddy currents in their copper discs caused by—what? Caused by the rotation of the disc in the magnetic field. The higher that rotation the

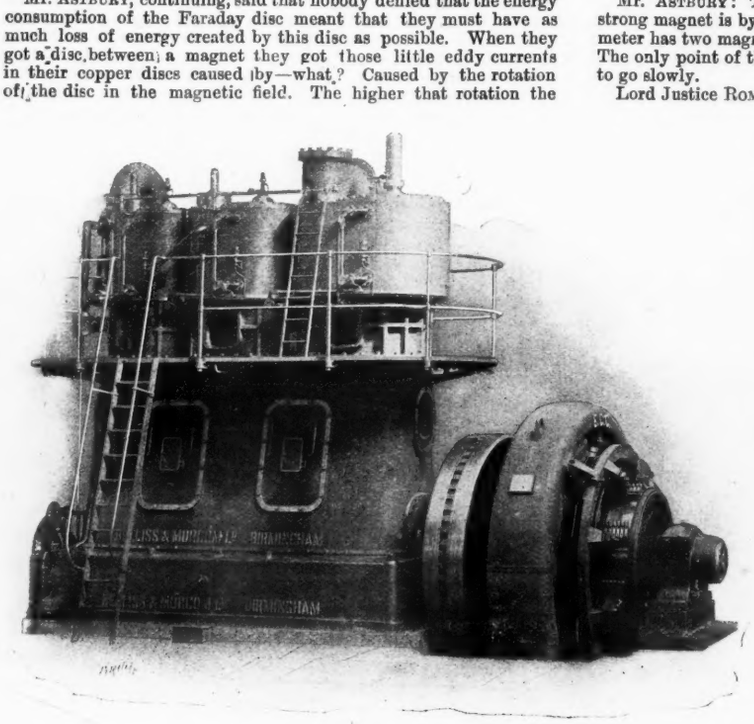


Fig. 2.—Belliss-E.C.C. Set for Traction.

greater the eddy current. Equally, the greater the magnetism the greater the eddy current, but consumption of energy in a disc was consistent with very high speed, because what a strong magnet would do at a low speed a weak magnet would do at a high speed. Now, if that was so, what became of the proposition that the suggestion of a magnetic brake necessarily meant low speed? He submitted that it did not at all. There was not a suggestion from beginning to end in Uppenborn's paper that they were to have low speed. If it was essential that there should be low speed in order to get a range, there was not a glimmer of it in this paper.

Mr. Bousfield: Nor is there in your specification.

Mr. Astbury said Hookham had shown how to make a motor and brake and he had explained how to make a magnet. The result of all that was that they could not get a high speed. He did not care whether Hookham expressly mentioned low speed or not. If his proportions were used, high speed was impossible, and he was entitled to all the benefits of it. Mr. Hookham was a commercial man who sold these meters by thousands. If there was the slightest alteration or the slightest variation in the strength of the magnets, what would it mean? Prof. Ayrton talked about permanent magnets in a sense totally different to Hookham. Hookham meant absolute permanence, whilst Prof. Ayrton, in talking about permanence, explained what he meant.

Lord Justice Romer: Do the other side admit that slow running is essential to success?

Mr. Astbury: Yes. It is absolutely essential, because if not slow running your meter would not measure. From a quick running meter you cannot get any range for your lamps.

Mr. Bousfield: We don't agree with my learned friends.

Mr. Astbury: I don't know whether that is so or not, but their meter only just turns round.

Mr. Bousfield: Some of our meters run 400 revolutions a minute.

Lord Justice Romer: Why is not the magnet just as good if it runs four times round with each lamp, because you can register any amount of speed?

Mr. Astbury: First of all, to get the result, it will rattle itself to pieces, because all the friction increases as the square of the speed. They would be increasing everyone of their frictional difficulties. Secondly, if they were to run their machine at a high rate of speed, they would be wearing out the parts. But the real answer was that there was no suggestion, so far as he could remember, that slow running was not an essential to success.

Lord Justice Romer: I don't remember that Mr. Swinburne pointed this out. At any rate, you will have to prove on the evidence that that is so—that slow running is an essential, and secondly, because you have not pointed it out in your specification, that your machine, from the way it is made with all its alternatives, must be run at a slow speed.

Mr. Astbury said he thought all this would be found in the evidence. The thing that was insisted upon more than anything else in Hookham's, was the large power of the magnet, and what was it for? Was there any conceivable reason for having a powerful magnet if it was not to keep the disc going slowly?

Lord Justice Romer: I agree you want to check it in proportion to your speed—no more than that.

Mr. Astbury: The possibility of range in connection with a strong magnet is by getting the thing to go slowly. The defendants' meter has two magnets on the brake, and what are they there for? The only point of the thing is to make the magnet strong in order to go slowly.

Lord Justice Romer: I don't say you cannot prove your point. How can you make out that under your patent, to the full extent you claim, it would not cover a slow-running machine?

Mr. Astbury: Because if you have a strong and powerful magnet, you cannot have a fast running machine.

Lord Justice Romer: Why not?

Mr. Astbury: Because you cannot. If you keep your brake down, the only point of the powerfulness of the magnet is to keep the disc slow.

Lord Justice Romer: But relatively.

Mr. Astbury said it was relatively in one sense, but what the patentee had done, and no patentee was obliged to do more, was that he had told them generally that they were to have a braking power very strong and constant. There he gave one example of the way they ought to have their magnet. There was no magnet known at the date of Mr. Hookham's specification which had anything like the power of defendants' magnet.

Lord Justice Romer: You want to get your equilibrium in your brake at a low speed.

Mr. Astbury: Yes, that is the whole point.

Lord Justice Romer: Because with a weak magnet you would always get, I suppose, your state of equilibrium, but you could only get it by running at a higher speed.

Mr. Astbury: That is the only point, and the sole point.

Mr. Astbury, on 25th ult., in continuing his argument on behalf of the appellants, referred to different portions of Hookham's complete specification with a view to showing that his invention comprised the five elements he had mentioned on Saturday.

Referring to Claim 3 of the plaintiffs' specification, Mr. Astbury said that claim was for the use of permanent magnets for the purpose of an electricity meter. It was not confined to a current meter. He (counsel) said it did not matter a bit if these magnets were old, and everybody had known how to make magnets for a meter, because the plaintiffs' specification was for a combination of parts.

Lord Justice Romer: Supposing that your Claim 3 was bad, then, unfortunately, for you, your patent goes?

Mr. Astbury: Yes, certainly.

Lord Justice Romer: Although if it had been a running patent you might have amended it possibly. But that is no good to you now. You claim in electricity meters "the use for the purpose of procuring a powerful and constant magnetic field of permanent magnets arranged as described with very large polar surfaces closely fronting each other so as to form a narrow slit," and so on.

Mr. Astbury said there not a word about permanent magnets in the provisional specification. In the provisional specification, Mr. Hookham said he wanted a constant, or nearly constant, field, and in the complete he pointed out that it could be got in different ways. The essence of his invention was how to get a constant and powerful field. Claim 3 was for a particular means in combination with all the other parts of the specification, where Mr. Hookham claimed to get that constant and powerful field.

Lord Justice Cozens-Hardy: What troubles me is that Mr. Justice Farwell seems to have based his judgment wholly on the result of the evidence.

Lord Justice Romer asked the learned counsel what his contention would be, supposing it was known with regard to permanent magnets, that if you had large polar surfaces closely fronting each other, with a narrow slit between them, the magnet became more powerful and more constant.

Mr. Astbury said that his Lordship had put upon him a little more than was suggested by the defendants.

Lord Justice Romer asked the learned counsel to assume that it was known that a magnet of the shape indicated was powerful and constant, and the common use—or one of them—was to use it to give a field.

Mr. Astbury: But not in a meter.

Lord Justice Romer: Your claim is for electricity meters. Your claim is that you want a field; you might want it for a clock meter.

Mr. Astbury: I do not know that you want a field in a clock meter.

Lord Justice Romer: Well, you might. You are simply saying that in an electricity meter "you may want a permanent and constant field, and if you do, take this well-known form of a permanent and powerful magnet, viz., the common horse-shoe magnet." In that case would your Claim 3 be good?

The learned counsel said he submitted that Claim 3 of the plaintiffs' specification claimed the use of permanent magnets arranged in certain ways for either the motor, the brake, or both.

Lord Justice Romer: It is not limited, you say. It has to be read as electricity meters for measuring current or energy, where you have the electro-motor and electric brake work substantially as pointed out in the specification.

Mr. Astbury agreed.

The hearing was again adjourned.

Mr. Astbury, on 26th ult., continuing his address on behalf of the appellants, said that the day before, with regard to the magnets, he had referred their Lordships to one or two passages in the defendants' witnesses' evidence, and he stated before doing that that he wanted to limit himself to the power of magnets. There were two points in Hookham's invention *quâ* the magnet. With regard to constancy only, their Lordships knew that the braking force of a magnet falls off as the square of the loss of strength, so that if a magnet fell 4 per cent. in strength, its braking force would be 8 per cent. less. That would not be contested. He now wanted to show their Lordships what Prof. Ayrton meant when he talked about a constant magnet. The professor called it permanent. The learned counsel then referred to the evidence of Prof. Ayrton given at the trial, when he said he had tested the magnets in the form of ammeters, and had made experiments with magnets 14, 15, 16, 17 years old, and in some cases they showed that the strength of these magnets to-day was only 2, 3, or 4 per cent. less than it was 16 or 17 years ago. Therefore, for all practical purposes, these magnets were constant. That was what Prof. Ayrton meant by constancy. He did not depart from it at all. Now, assuming that he was right—the plaintiffs did not admit it in the least—it was a magnet absolutely and entirely useless for a meter. It would not make a meter. These were magnets which were aged first, and supposing you put them in a meter, and they lost 2, 3, or 4 per cent. in strength, that would not be a meter.

Lord Justice Romer: 16 or 17 years is a long period.

Mr. Astbury: Not for a meter. Continuing, the learned counsel said that Prof. Ewing was asked, if a magnet did fall off in strength, when would the fall off occur in the life of the magnet. Prof. Ewing stated that if the magnet was going to fall off in constancy, the greatest fall would be in the first six months. Ferranti said it, too. The learned counsel asked what would become of your meter in such a case, in six months, and said it would not be a meter at all. There really could be no doubt about it. He was now only on the question of Claim 3 of the specification. With regard to the fall off, there were three witnesses against him, Profs. Ayrton and Ewing and Mr. Ferranti. Prof. Ewing stated that his was guesswork, and Ferranti stated that his was only hearsay.

Mr. Cripps, in opening the case for the respondents, said he thought it would be convenient if he stated first of all what the defendants' case was; what they relied upon, and what appeared to them to be in substance the judgment of Mr. Justice Farwell. Now the defendants' case was twofold. First he said that the defendants had done nothing which was not common knowledge—not common public knowledge at the time that Hookham's patent was brought out. That was putting the case in a very simplified form, but that view was taken by Mr. Justice Farwell. The second point was this, that assuming that the defendants had to show they had not infringed Hookham's patent, they had to ask themselves what that patent was. Well, there were only two claims of that patent which it was said the defendants had infringed. One was the first claim. That was combination, none of the elements of which had the defendants taken. Of course that was a matter of evidence. The other was Claim 3. He did not care whether that claim was dealt with as a subordinate claim or as a claim in itself. It was a claim for a particular form of what was called a built-up meter, which was very carefully described in the specification, and which was entirely and wholly different from anything the defendants did.

Lord Justice Romer: You say the magnet was not used by you.

Mr. Cripps said that what Mr. Hookham claimed, and what he rightly claimed, was a particular form of built-up magnets, suitable not only for braking, but for braking and motor purposes. This was quite distinct from anything the defendants used for braking purposes alone. Mr. Hookham had built up for these two purposes a magnet which he very carefully described, and which was built up, he explained, for constancy and strength. The defendants did not like that, nor did they want the same class of meter as Mr. Hookham did. Why Mr. Hookham wanted it constant and powerful, was because he used it for motor purposes, and as regarded the mere brake, it was necessary to have it what had been called constant and powerful. The defendants' object did not come within that definition, even using it in the widest term, although he should submit the claim was far narrower than that. Now, as regarded the first point, the defendants' case was not a very long one. The principle which underlay Mr. Hookham's invention was what was called the straight line law, that was, getting not the proportion of the square, but the direct proportion between the motor power and the brake power. Now there was no doubt that Profs. Ayrton and Perry fully explained that law as applicable to meters. He did not say they showed a practical way of carrying out the law—he had not got to argue that—but they showed the principle as applicable to meters. Now Deprez pointed out that if they had something in the nature of a brake revolving in a fluid they did not get the straight line law. He then went on to show how by having a copper disc rotating between the poles of a magnet the effect was to develop in the interior of the disc induced currents, following the well-known law applied in his speed indicator. Deprez then went on to state the problem and how it had been solved. The problem was solved, and it was quite immaterial whether they had a strong magnet or a weak one. As Mr. Ferranti had pointed out, the only difference was that with a weak magnet the disc travelled faster, and there was, therefore, a tendency for the bearings to wear out sooner. That was the only difference, and as regarded the law it did not matter one iota.

Lord Justice Williams: Your opponents say it affects the range.

Mr. Cripps said it did not, with great submission; but supposing it did, nothing depended upon it in the present case.

Lord Justice Williams: It is suggested, you know, that Mr. Hookham points out that you must have a particular form of magnet in order to obtain power and constancy.

Mr. Cripps said he would come to that. What he would point out at present was that so far as the brake was concerned, that was not necessary. Of course, there must be constancy. That was the assumption of the whole of the mathematical problem here. Every witness upon this point had treated it as a matter of degree. Suppose they aged what was called a strong magnet, and then aged a weak one, the weakening would be in a corresponding degree. That was all. There was no invention in that. It was as old as the hills. But what was there in the case of the argument as to a powerful magnet? The defendants used two weak magnets. They did use three, but now they used two. They might have used 20 had they liked. It was perfectly pointed out by Deprez that if they did that in connection with a disc they would get a straight line law. The strength of the magnet did nothing more than this, than it made the disc turn more slowly. It did not affect the law. As regarded the range of power point, he differed from his learned friend, but supposing he was wrong, it did not matter.

The hearing was then further adjourned.

Mr. Cripps, on 27th ult., continuing his opening address on behalf of the respondents, said that his first point was that the respondents, as regards the meter they used, had done nothing more than what was common knowledge at the date when Mr. Hookham brought out his patent. That was the part of the case on which he laid the greatest stress before Mr. Justice Farwell. His learned friends had said why did not they have a meter at an earlier date? They had it quite as early as Mr. Hookham had his. Until a certain point, neither the one nor the other was wanted, because electric lighting did not develop much until a later date. The commutator the defendants applied to Siemens's motor was absolutely and entirely different to the plaintiffs. All the defendants had to do was to apply to Siemens and Marcel Deprez a silver commutator, with silver tipped brushes. There you had the whole thing, and nothing more was wanted. Then it was said, what about the magnet part of it. Well, he (counsel) had already indicated one answer to that, viz., that the magnet part of it had nothing to do with the electrical equipment of the machine, it merely had to do with its economical user. He thought that every witness when talking about constancy and power had said that each was a matter of degree. He (counsel) had put it to them that if you found in a particular meter the magnet put on allowed your disc to run too fast, you could put on another. That was what the defendants did. There was no mystery in that. The defendants did not use any particular form of magnet. What Hookham did was to build up a particular form of magnet, not for braking purposes only, but both for motor and braking purposes. The particular form of magnet he built up was necessary, because it had to serve a double purpose, the motor and the brake. That was the reason of it. For the brake alone no special form of magnet was required in that sense. When he came to read the evidence it was clear the magnet the defendants used was nothing more than was described as the common horse-shoe magnet. It was, of course, aged and magnetised in a particular way by the defendants, but that had nothing to do with what the plaintiffs did or suggested. The defendants' was quite a common form of magnet. It was sufficient for his purpose to show that it was a thoroughly old-fashioned shape and long before Hookham's. He would read the evidence on that point.

In answer to a question by Lord Justice Romer, the learned Counsel said the defendants got over the difficulty with regard to the friction by the silver commutator. Mr. Hookham gave his evidence very frankly in the case, and he and the other witnesses on his side admitted that so far as the commutator was concerned the defendants added to Siemens and Deprez, and there was no question between the plaintiffs and the defendants that the defendants was an absolutely different commutator from the plaintiffs.

Lord Justice Romer: They do not challenge it?

Mr. Cripps: No.

Continuing, the learned counsel said that what stopped Ayrton and Perry was the commutator point, and that was the same with Ferranti. The commutator stopped them. Everybody knew about these things, but all were kept back at one point—the commutator. The defendants added to Marcel Deprez and Siemens a commutator,

which had nothing to do with the plaintiffs. Therefore, so far as the commutator was concerned, there never had been and was no question between the plaintiffs and the defendants. The defendants were entitled to use common knowledge for any purpose.

The hearing was adjourned.

Mr. Cripps, on 28th ult., continuing his argument, said that before proceeding with reading the evidence, he wished to call their Lordships' attention to what he considered important points applicable to this case. He thought it would clear the ground as to his future position. The first point leading up to common or public knowledge was this, that the principle on which the defendants' meter depended was known, and was known as applied to meters. That was what was called the straight-line law. There was no question on that point. The next point was that a magnetic brake was known. He used the word in its widest sense. The magnetic brake was nothing more than the retarding power of the magnet on the copper disc. The next point was that a combination of motor and brake was known. The straight-line law was mathematically proved by Marcel Deprez, and they further had the fact that the combination referred to by Marcel Deprez formed a meter. He did not say the best meter, but still a meter. It formed a meter. The next proposition was that Marcel Deprez's was a very careful mathematical demonstration, involving constancy of the magnet. Apart from that accurate mathematical demonstration, constancy was, after all, a matter of degree. That was, however, another point.

The learned counsel proceeding, said he thought he had better deal with the interpretation of the plaintiffs' claim. They had two claims to deal with, the first and the third. Now, the first was a combination claim undoubtedly, but it was limited in the first words to an "electric meter for measuring currents consisting of an electro-motor with constant field." So they had there what was called a current meter. It was limited to that, and excluded an energy meter. Both firms were well known at that time, and, in fact, in the same year Mr. Hookham brought out a patent for an energy meter. An energy meter and a current meter were well known in electrical science as denoting two different machines absolutely distinct. Now, as regarded these two well known and different electrical machines, his learned friends said that under Act of Parliament the variations of pressure must be constant within certain limits, and they said that for this purpose energy and current meters were made the same machine. That was absurd on the face of it. Mr. Hookham, as perhaps he was well advised to do, limits his claim to a current meter, and it has to be construed as such. In the case of Hookham *v.* Johnson, Mr. Hookham relied upon this very fact, and he said: "I am not anticipated by Ayrton and Perry, because theirs is an energy meter, and I have limited mine to a current meter." If anyone in his claim limits the thing in that sense it did not matter so long as no one else came within the limits laid down by the inventor himself. What was claimed was what was invented, but he went beyond that as regards combination. Counsel said that their combination was nothing like Hookham's. The two were absolutely distinct.

Lord Justice Williams asked a question as to Claim 3.

Mr. Cripps said that he would rather confine himself at first to Claim 1, but as to Claim 3 he would point out three matters. First of all, he thought that Claim 3, in proper construction, did not go outside a current meter. Secondly, it did not deal with the magnet on the brake, but the magnet on the disc armature; and, thirdly, as regarded the form of the magnet, it was entirely different from the defendants. All these three points were argued in the Court below, and were accepted by the judge. But, to return to Claim 1, the inventor claimed "an electricity meter for measuring currents, consisting of an electro-motor with constant field arranged substantially as hereinbefore described and illustrated in the accompanying drawings." Now, that differed in every respect as a combination from the defendants, because such a combination would be destructive to an energy meter altogether, because it was limited to a constant field, whereas they wanted two varying fields, and this was essential to their meter. Then Hookham went on, "the said electro-motor being combined with an electric brake." There was nothing new in that part of the combination, the combination of motor and brake. Then to continue, "in a constant, or nearly constant, field." The words "nearly constant" were introduced as an amendment, but he agreed to "nearly constant" because they could not get perfect constancy. They got practical constancy. Then he said, "preferably the same field as that in which the armature rotates." Well, of course, that would be impossible in the defendants' case, as it would be destructive of what they did. It was impossible, as he should submit, to say that Mr. Justice Farwell was wrong in coming to the conclusion, and it was one of fact that the defendants were infringing with a machine which was essentially different.

Lord Justice Romer: They say that, assuming yours was an energy meter, you have put in the compound winding, which practically turns it into a current meter.

Mr. Cripps said it was a very simple thing. The compound winding, under the conditions in which it was used, did not interfere with the energy meter *quâ* energy meter at all. As regarded the first claim, his contention was that the defendants' combination was nothing like it. As regarded the third claim, he submitted that according to its proper construction it did not go outside a constant magnet; it dealt with the action of the magnet on the disc armature, and the form of the magnet was distinctly different from the defendants. Mr. Justice Farwell was amply justified in finding that the defendants' meters did not infringe the first claim, and he proposed to call attention to the evidence and to the judgment of Mr. Justice Wills and Mr. Justice Farwell for the purpose of showing that there was no infringement of the third claim.

Lord Justice Williams thought the Court would like to hear what the appellants' counsel had to say upon Mr. Cripps's first proposition that the plaintiffs were not using anything which was not common knowledge at the time of Hookham's patent.

Mr. Moulton submitted that there was an absolute lack of any public knowledge which would suffice to make a practicable meter in Hookham's scheme in 1887. This was a case in which the plaintiffs had always admitted that the theory of a meter of that kind was known at that time, but what they said, and against which there was not a particle of evidence, was that nobody had made, or could make, a meter according to that theory till Hookham showed how it could be done. The plaintiffs' case was that, stopping at Marcel Deprez, no practical meter would have been made without subsequent invention, because it would not have registered or measured properly. Substantially, Deprez's meter would not have measured at all. Having dealt with the question of prior knowledge, Mr. Moulton then addressed the Court on the points arising on what it was alleged the defendants had in their meter taken from the plaintiffs. He contended, first of all, that the success of the defendants' meter depended upon the magnets which Hookham taught them to have.

The hearing was adjourned.

Mr. Moulton, K.C., on 29th ult., in continuing his reply on behalf of the appellants, submitted that Mr. Hookham had made a substantial invention of very great value quite independently of his meter. He meant there was a subordinate invention in his meter. Mr. Swinburne in his evidence at the trial said: "I think the electrical world is indebted to Mr. Hookham for the knowledge how to make strong permanent magnets." He (counsel) should take that as his text. He wished to point out that that was a definite invention, and a most important invention. What Mr. Hookham produced was an absolutely permanent magnet. He meant by that one in which you could not note change when your meter went on working year after year without its readings changing in value. Nothing of the kind had been shown to have existed before. The question for the Court was whether Mr. Hookham's invention had been taken by the defendants. With regard to the point of whether the defendants' was a current or energy meter, the learned counsel said that every current meter must be an energy meter if it was put on a constant pressure circuit. He did not think that their Lordships could believe that the defendants' meter was to measure energy and not current.

Lord Justice Cozens-Hardy: There is an accurate mode of measuring Board of Trade units.

Mr. Moulton said that what the defendants' meter was intended to measure was the amount of current. The plaintiffs' meter recorded just the same things as the defendants'. All these meters were used simply to record current, which current was taken at 100 volts. The brake was exactly the same in all cases. The brake counter-balanced the energy of the motor, whether it was in an energy meter or in a current meter. In conclusion, the learned counsel argued that if it were true that Mr. Hookham had enabled the world to make these valuable magnets which removed the difficulties of braking, he had properly described it and properly claimed it. He also asked their Lordships to find that the defendants had infringed the plaintiffs' first and third claim.

Lord Justice Williams said that he and his learned brothers would consider this part of the arguments, and if they wished to hear further arguments on the other points in the case, they would let counsel know.

The Berliner Telephone Manufacturing Company *v.* The Thames Electrical Manufacturing Company.

In the Lord Mayor's Court, London, before the Recorder on December 10th, this action was brought by the plaintiffs to recover the sum of £15 5s. 11d, the price of electrical fittings, such as telephones, &c., supplied by them to the defendants. Mr. W. Valentine Ball appeared for the plaintiffs, while Mr. Blaiklock represented the defendants.

According to counsel's opening statement, the goods were supplied to the defendants in pursuance of four orders, dated respectively June 12th (£2 8s 0d.), September 2nd (£8 15s. 5d.), September 12th (£3 0s. 8d.), September 26th (£1 1s. 10d.) There was no dispute as to the sum of £2 8s. 0d., which was paid into Court. Towards the end of September, the plaintiffs applied to the defendants for payment for the whole amount outstanding. Receiving no reply, they made a further application on October 9th, when the defendants sent a cheque for £2 8s. 0d., and said: "We have also a statement from you for £12 17s. 11d., and if you will give us 5 per cent., we will forward you cheque." To this the plaintiffs replied on the same day: "We shall be pleased to allow you 5 per cent. discount off the balance outstanding providing same is paid by return. The amount will be due for payment less 2½ per cent. on the 20th inst." No cheque having been sent, proceedings were instituted in the Mayor's Court on October 15th, the cheque for £2 8s. 0d. having been dishonoured in the meantime. The learned counsel submitted that on the above facts there was a binding contract.

Frederick Hooker, a clerk in the plaintiffs' employment, was called as a witness, and proved the above facts. In cross-examination, however, he admitted that the original order of the defendants had printed on the back:—"Goods supplied from the 1st to the 20th of the month are due for payment on the 20th of the following month, less 2½ per cent. discount."

In these circumstances Mr. Blaiklock submitted that except in respect of the sum of £2 8s., the action was premature, as payment for goods supplied in September would not fall due until October 20th.

Mr. Ball argued, on the other hand, that a new contract for the payment of £12 17s. had been entered into on October 10th, by the defendants' offer and the plaintiffs' acceptance of immediate payment at 5 per cent. discount.

The learned Recorder eventually withdrew the case from the jury. He said that there was no new contract on October 10th, as the plaintiffs had only given a conditional acceptance of the defendants' offer by saying "if cheque sent by return." On the other part of the case it was clear that the action was premature. He greatly regretted that, as the merits were on the plaintiffs' side, he was compelled to enter judgment for the defendants with costs.

Walker *v.* Elmore's German Metal Company.

In the Court of Appeal on 11th inst., before Lord Justices Vaughan-Williams, Romer, and Cozens-Hardy, this case was heard, on appeal by the plaintiffs from an order of Mr. Justice Buckley, who had refused an application for an injunction to restrain the defendant company from issuing certain debentures. Their Lordships came to the conclusion that Mr. Justice Buckley was right, and dismissed the appeal.

CORRESPONDENCE.

Municipal Competition.

Your well-written paper, headed as above in your issue of the 6th inst., would be read with remarkable approval by all engaged in the electrical trades throughout the country.

Sir Courtenay Boyle, in examination before the Select Committee of the Houses on "Municipal Trading," laid it down as the Board of Trade principle in regard to orders given to municipal or private electric supply companies that permission was refused to make, sell, or supply fittings, or to do inside wiring, whether for lighting or power work, but to limit their powers to the supply of energy, together with the supply of meters, for current measurement (Parliamentary report, pp. 80 to 97).

Parliament in 1898 refused the Order passed by the Board of Trade to allow the Vestry of Marylebone to compete with rate-aided capital against invested capital, establishing the principle that the rates of a municipality should not be used to actively compete against their own ratepayers, who have invested capital and trade interests at stake.

The gas companies instituted the abuse, and got such powers as, for instance, the Morecambe Urban District Gas Bill gives, empowering them "to purchase, sell, or let for hire, gas engines, stoves, ranges, pipes and heating apparatus, for which gas can be used;" and in spite of the above declaration the abuse is spreading, and, at the present moment, a great many Bills are before us applying for similar unfair powers.

Obviously the time to fight these would-be monopolist institutions trading without fair business premises, trade expenses, &c., and on the public rates, is to appeal against such abuses when powers are applied for.

How can this best be done? I think, in the first case, by giving the non-technical public in every district concerned, either through the local press, ratepayers, societies and similar mediums, a true knowledge of how such abuses will re-act on themselves, by creating huge monopolies preventing the acquisition of all the latest developments and improvements so rapidly succeeding one another in the electrical trade.

2. By influence of the Councils and local Parliamentary representatives.

3. By amalgamation with kindred societies to oppose, by best Parliamentary counsel, the Bills, unless such objectionable clauses be expunged. A few precedents once established would save continuous efforts. The architects', consulting engineers', and plumbers' associations should combine, for all are sufferers from such abuses.

4. The danger of these huge municipal loans must be brought home to the public. They bid fair to exceed the National Debt of the Empire in the next 10 years.

Such spending powers are a huge temptation to interested financial exploits, and to bring our local councils into Municipal Tammany, where too many representatives have their own axes to grind, and not always to the ratepayers' benefit.

Without wishing to be unfair, or to make wholesale charges which might seem cowardly, for it does not as yet, I hope, apply to the majority, it must be obvious to any thinking person who has watched the change in the representatives of Local Councils over the last 10 years, that many have interests, both direct and indirectly, which should, and used to be absent, until these spending emoluments tempted them into such prolific fields of gain and influence.

In conclusion, I would point out to electrical contractors that the first and most important item on the agenda for discussion at the next public meeting of the North of England Association, to be held at Manchester on Saturday, January 18th next, is this question of Municipal Trading, and I trust all the local associations will send with their respective delegates authenticated statements, showing how far the abuse is already spread in the Northern Counties, and that the discussion, to which architects, consulting engineers, and similar interested persons are invited, even though their present sympathies be with our opponents, for every straightforward action founded on right gains by comparison with its converse, will result in a practical business course being followed to prevent, in both the public and trade interest, the recurrence of such dangerous powers being allowed.

It would conduce to our interests if local secretaries will forward to the Northern secretary, Mr. W. Cross, 4, St. Nicholas Buildings, Newcastle-on-Tyne, not later than the 10th prox., all statistics bearing on the question, in order that they may be tabulated for assistance in the debate.

Apologising for the length of this letter.

Henry Bland,
President Northern Section, National Association of Electrical Contractors.

December 16th, 1901.

A Question of Etiquette.

I should very much like to know the etiquette of the following circumstances:—Should one, or should one not, when seeking a situation, send stamp for reply? Being on the large, increasing company of the unemployed, I study my Electrical Review very carefully. I have been accustomed to reply to about six situations per week. I have always sent stamps. I *may* hear from one per week (I have heard from three in six weeks). You may say that a penny stamp is of no value; well, if I belong to the aforesaid company for three months, five stamps per week being wasted—I do not count the outward stamps or the one that replies as wasted—that is 5s. absolutely thrown away at the very time one could do with it.

Most fellows, I think, send a stamped addressed envelope for reply, as you certainly won't get one if you don't. Here is an example:—

I applied for a berth on a large municipal undertaking in the North of London; no reply, so I called. I was politely informed that over 800 persons had applied. 800 pence, say half sent stamps—£1 13s. 4d. Surely typewriters are cheap enough, and, unfortunately, clerks cheaper still.

Trusting you will allow me to ventilate this grievance in your columns, and that others, especially employers, will air their views.

Jackanapes.

Drop Forging.

I should be glad if someone would give me a short description of the process of "drop forging." I notice that many articles are advertised "Drop forged," and I cannot find out anywhere an explanation of this term.

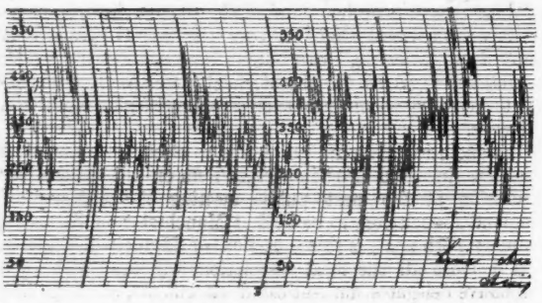
Werdna.

December 13th, 1901.

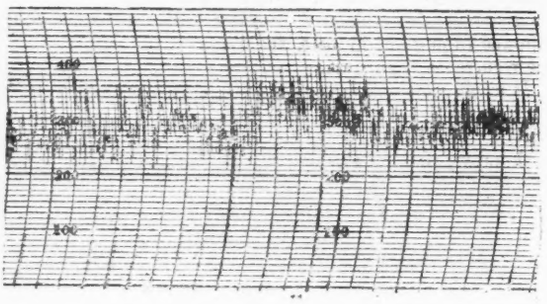
Accumulators and Electric Traction Systems.

In your issue of December 13th, under the heading of "Accumulators and Electric Traction Systems," I notice you refer specially to the advantage obtainable by the use of a

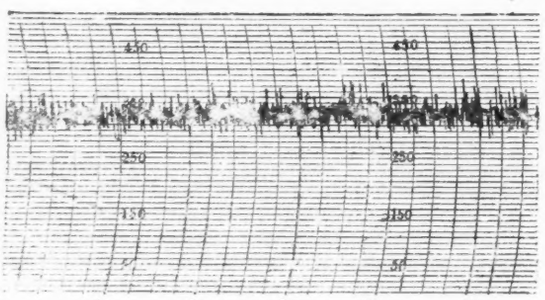
reversible booster. Perhaps a few curves in illustration and in corroboration of this advantage may be of interest to your readers.



Curve 1.—Shows the output of a traction generator working without battery or booster, the wide fluctuations of load being apparent.



Curve 2.—Shows the steadying effect produced by a battery in parallel with a generator.



Curve 3.—Shows a still further reduction of the variations by employing an automatic reversible booster in conjunction with a battery.

E. S. W. Moore.

Brakes.

Would you be good enough to allow us to comment upon points arising out of your leading article on brakes in your last issue? The question is so important that a few remarks cannot be out of place.

Two combinations of brakes are there suggested—(1) a mechanically operated slipper, with a rheostatic or a disc brake, and (2) an electro-magnetic slipper brake, and the ordinary wheel brake. Neither of these appears to us to be satisfactory, for the following reasons:—

Every car should be provided with two kinds of brake, one for regular service work and the other for use only in an emergency. In the first combination suggested, the mechanically operated slipper brake is quite correct for emergency purposes provided it can be fully applied instantly without much effort on the part of the driver, and if its connection with the truck is not so rigid as to damage the car and shake the passengers when suddenly applied (we presume that by a mechanically operated slipper brake is meant any slipper brake which is not operated electrically). For service work, however, the rheostatic brake is open to serious objection, since it is inoperative if the trolley leaves the wire and the wheels begin to skid.

In the second combination the ordinary wheel brake is sufficient for service work, but the electro-magnetic slipper brake is liable to fail just when it is most required. Suppose that a car gets beyond control on a gradient with a greasy rail; the wheel brake is sufficient to cause skidding, and if the trolley leaves the wire, as it probably would at the first loop, the electro-magnetic brake is entirely inoperative.

Skidding is so common on a greasy rail that no brake thereby rendered inoperative is suitable for emergency purposes.

In his official report to the Board of Trade on a recent accident at Ramsgate, Major Pringle concludes that the rheostatic brake was rendered inoperative owing to the wheels skidding through a too powerful application of the hand brake.

In an emergency, drivers are liable to apply every available brake to the utmost of their power, with the result that those depending upon the revolution of the wheels are rendered useless.

Bearing these facts in mind, and judging from our own experience of some of the steepest gradients in the country, we are driven to the conclusion that the best combination of brakes is a slipper brake (not operated electrically) capable of instantaneous application without much effort on the part of the driver, and the ordinary hand-wheel brake. A combination of a pneumatic slipper brake and an ordinary hand-wheel brake is working in Oldham and Stockport, where gradients varying from 1 to 10 downwards occur and where the rails are greasy at least six months in the year, and is giving every satisfaction.

Viewed from an entirely commercial aspect, apart from other more imperative reasons, it is economical to provide the safest possible combination of brakes, since a few accidents on any electric line may easily prove more costly than the total brake equipment.

Hewitt & Rhodes.

Manchester, *December 17th*, 1901.

[We quite agree that if the wheels are skidded by the hand brake, the electro-magnetic brake, whether of the rheostatic, disc or slipper type, ceases to be of service. We fail, however, to see what the trolley has to do with the question; surely our correspondents are aware that electro-magnetic brakes are operated by the motors acting as dynamos? The rheostatic brake alone may momentarily skid the wheels, but directly this happens the current ceases and the wheels again revolve, so that continuous skidding is impossible. Of course, the pneumatic slipper brake is free from this objection.—Eds. Elec. Rev.]

The Crawford-Voelker Lamp.

In your issue of December 6th there is an article by F. Z. Maguire on the Crawford-Voelker lamp, containing a number of extracts from a report on the lamp by Col. Holden, which I think it is necessary to examine somewhat closely. By taking extracts from Col. Holden's report, instead of giving the report in full, it is made to refer to lamps of quite another class to those tested and actually reported on, and thus might mislead any person not well acquainted with the subject.

Col. Holden, in his report, says:—"I instituted a test of 50 lamps, which was started on February 27th, 1901, and continued without a break, except to allow of the lamps being measured electrically and tested photometrically for 1,000 hours." It is not stated in the report what was the voltage and the candle-power of the so tested lamps, and no mention whatever is made of the class of lamps tested. This vital omission is most misleading.

The report goes on to describe the test, and gives the efficiency at the start and the efficiency (of the survivors) after 500 hours and 1,000 hours, but no mention is made of the voltage. The efficiencies given are:—

At starting ...	...	... 2·535 watts.
After 500 hours ...		... 2·845 „
After 1,000 hours ...		... 3·35 „

The writer of the article ingeniously works in a statement made by Sir Wm. Preece as regards his test on 8-c.p., 200-volt lamps (which are difficult lamps to manufacture) as follows :—

200-volt Lamps, 8-c.p.

At start	...	...	... 4·21 watts.
After 400 hours	...	...	5·74 „

He then proceeds to compare the Crawford-Voelker lamps (of unknown voltage and unknown candle-power) with the 200-volt, 8-c.p. lamps tested by Sir Wm. Preece, and he finally concludes with a statement that the Crawford lamps show a superiority of 41·6 per cent. after burning 1,000 hours, as compared with the 200-volt, 8-c.p. lamps after burning 400 hours.

To anyone acquainted with the subject the omission of the voltage and candle-power of the lamps under test is obviously misleading. Even the youngest electrical tyro knows that the behaviour of a 16-c.p., 100-volt lamp and that of an 8 c.p., 200 volts are very different, and that lamps of the two classes are not fairly comparable, yet this comparison appears to have been made by the writer of the article in question.

For some years past lamps have been made and sold in the open market of 16 c.p., 100 volts, with an average life of between 600 and 700 hours, an initial efficiency of 2·75 watts and an efficiency of 3·35 after 600 hours, and if the lamps tested by Col. Holden were of this class it is quite evident that they are in no way superior or likely to be superior to those which have been for quite a long time readily obtainable.

F. J. G.

[We must take upon ourselves the responsibility of making extracts from the report of Col. Holden, which was placed in our hands *in extenso*. We cut it down merely to economise space, omitting only parts which seemed not to be essential. It would have been better if the report had definitely stated that the lamps tested by Colonel Holden were 8 c.p., 200 volts ; it is, however, plainly implied that such is the case. Perhaps the writer of the article, Mr. F. Z. Maguire, will furnish further particulars which will satisfy our correspondent.

The widespread interest excited by Mr. Maguire's article has been brought home to us by the number of inquiries regarding it which we have received, and the manner in which it has been quoted in the daily press throughout the country. Up to the present we have not been in a position to speak from our own knowledge as to the merits of the lamp, beyond recording our impressions derived from a visit to the laboratory ; but if the inventors care to place, say, a dozen or more of their lamps in our hands, we shall be pleased to carry out a thorough and impartial test of their efficiency, durability and constancy, free of cost to them, and to record the results in our pages.

Every innovation is subject to attack in its earlier stages —there are even electrical engineers who fail to realise that a higher efficiency is to their advantage in the end—and it is solely with a view to satisfying ourselves as to the merits of the new lamp that we make this offer.—Eds. Elec. Rev.]

Batteries and Boosters for Electric Traction.

On page 992 of your issue of December 13th there appears a statement of so misleading a character that we should be glad of an opportunity of removing the erroneous idea which it may create.

In the course of a description of a booster system for a traction load you state, "In very few instances, however, is the extra expense and complication caused by a reversible booster really necessary, as it must be remembered that although the booster helps the battery to discharge at or near its one-hour limit, it must consequently be working the battery very hard, and it is claimed that if the money which is spent on the boosters and switching arrangements is expended in putting in a larger battery, the battery will be sufficiently elastic to give all the regulation that is necessary, and at the same time, owing to its being larger, it will not be worked to the same extent."

So far as your description of the apparatus informs us, it is only at present working in a single station, which is, perhaps, some explanation of the views expressed, which are quite at variance with actual practice. An *automatic* reversible booster, requiring no alteration by hand of the reversing point, most certainly does not cause complication, and needs less attention than a machine which must be frequently adjusted according to the variations of the load. The suggestion that a one-hour rate of discharge is too onerous for the battery is one which savours of the last century, and does not, we think, trouble up-to-date manufacturers. A one-hour rate *per se* is in no way injurious to a Planté type plate of suitable design and construction, if it is not continued until a dangerous drop in E.M.F. occurs, and this is one of the important objects which an automatic reversible booster obtains. By its use the heavy calls for current made upon the battery are immediately returned to it directly the line amperes fall, and consequently the E.M.F. per cell on discharge approximates 2·08 volts, even on a one-hour rate. It therefore follows that the watt-hour efficiency is much higher than if the battery were discharged to a comparatively low voltage per cell and charged at longer intervals.

Of course, it must not be understood that a booster designed to work as shown by the diagram would for a moment be entertained by us, or should, we think, be accepted by any competent engineer for the purposes of a reversible booster, as a more ineffective and inefficient method of endeavouring to obtain the results desired, can scarcely be conceived, quite apart from the fact that the whole principle by which regulation is sought is wrong.

The suggestion that the money necessary for booster and switchgear should be put into a larger battery, which would "give all the regulation necessary," is very misleading.

A battery in plain parallel with the generators drops its volts in proportion to the discharge taken from it. If it is discharged through an automatic reversible booster, not only is its drop in volts compensated for, but owing to the fact that the current taken from it is immediately returned, the exhaustive and destructive effects which ordinarily result from a rapid discharge are altogether nullified, and, consequently, it is practicable to work the battery at a much higher rate than would otherwise be possible, with the result that with an automatic booster a battery of a given size can take care of very much larger fluctuations than it could do if it were not discharging through a booster.

We venture to think, moreover, that the station engineer would not regard an extra two hours' run per day for the sake of completing the charging of the battery with the same complacency that such a course is put forward.

The general tenour of your remarks recalled to our mind a fable touching a fox, but with Christmas so close upon us we dismiss the thought.

Chloride Electrical Storage Syndicate, Limited,
G. A. Grindle.

London, *December 18th*, 1901.

Mixed.

In the *Evening News* of Tuesday there appeared a long description of an invention by a Parisian dentist, who claims to have discovered the art of seeing through the telephone. The reading of this gave me a restless night, and early this morning I sat in my room, by the dim light of a fire, on which I melted some enamel, as did the Parisian dentist, and awaited results.

No figures, no colours, appeared on the walls of my room, but my telephone went tick, tick, tick !

Was this a message from Mars, from Tesla, or from Marconi, or was it that ubiquitous letter "S" knocking about through recent atmospheric disturbances?

I shall attach an incandescent lamp of $\frac{1}{10}$ c.p. to the disc of my telephone—this is what the Parisian dentist did—and if I see anything remarkable in the exchange to which I am connected, or in its *personnel*, I will communicate with you again.

Do you think Mr. Yerkes, the Rothschilds, or Mr. Whittaker Wright would be prepared to back me financially ? The Parisian dentist says that he expects the

contract between himself and the French Government may be signed any day. He only asks £1,000,000 for the invention, which costs about 15s. to apply to one's telephone; and when he has got through with the French Minister he is coming over here to dispose of his English rights.

What effect will this have on the agreement between the Post Office and the National Telephone Company? It is conceivable that the terms of the agreement will at last be seen through!

Dotty.

P.S.—Is the *Evening News* to be relied on when dealing with matters of scientific interest?

Cable v. Electric Traction.

Referring to the paragraph in last week's issue on "Cable *v.* Electric Traction," you do not mention the Glasgow Subway Company. We understand that this company's expenses with cable traction work out very much less than other concerns of a similar nature driven electrically. Can any of your subscribers say if this is actually the case?

A. B. C.

[Our correspondent, has, perhaps, overlooked the fact that the cable lines referred to in the note in last week's issue were *tramways*, *i.e.*, *street* lines, not lines partaking of the nature of tubes or underground lines. The Glasgow Subway is underground throughout, and should be compared with the electrical underground lines rather than with surface tramways.

So far as our information goes, we believe the actual working expenses of the Glasgow Subway are very low per train mile, and may possibly be considerably less than the figure for any of the London electric tubes, which is perhaps not altogether to be wondered at with coal half the price in the North that it costs in London.

But, as we are almost tired of pointing out, there is more to be considered than cost alone. A coster is able to drive to Epsom races on his donkey barrow for much less outlay than a finely-equipped coach and four costs the rich American; and we cannot help thinking that even the good Glasgow folks would prefer paying a little more in the way of fares or would travel much more often if clean, comfortable, well lighted and warmed carriages—like those on the London tubes—propelled by a smooth and *reliable* electric traction system, were to replace an extremely noisy, ill-smelling, and very uncertain wire rope.

The fact of fares having lately undergone considerable reduction upon the Glasgow Subway, tends to show that the extensive electric tramway system on the Glasgow streets overhead has exercised a material influence on the Subway receipts. The only remaining effort which the Subway directors can make in the way of improving their dividends from practically nothing to at least 4 or 5 per cent., is to throw out the cable at once and spend an extra 15s. in order to earn an additional sovereign.—Eds. Elec. Rev.]

BUSINESS NOTES.

The "Batten" Rectifier.—The General Electric Company (1900), Limited, have issued a circular of their "Batten" patent rectifier for charging small accumulators, exciting spark coils, or driving small motors, where direct current is required but only an alternating current is available. The apparatus is a polarised relay, whose tongue moves synchronously with the alternations of the current, and sends unidirectional impulses into either of two paths, which it opens for itself, and is independent of alterations of frequency or voltage. It will work with a much lower percentage of wasted energy than would result from doing the same work on a direct current circuit through charging lamps. It starts at once at full load, without speeding up, without expert attendance and without delicate mechanical starting devices. It will carry six amperes at 50 volts and a larger current at lower voltages.

Electrolytic Alkali Company.—Messrs. D. Bruce Peebles & Co. have secured the contract for the supply of eight 250-H.P. double-commutator 2,500-ampere generators for the above company. This plant when completed will form one of the largest electrolytic plants in the country.

Electrical Wares Exported.

Week ending Dec. 18th, 1900.		Week ending Dec. 17th, 1901.	
Alexandria	Value £70	Amsterdam	Value £50
,, Teleph mat. ..	92	Bangkok	21
Amsterdam	40	Bombay	487
Bangkok	64	Buenos Ayres. Teleg. mat. ..	108
Buenos Ayres	942	,, Teleph. cable ..	75
,, Teleg. wire ..	644	Calcutta	195
Calcutta	546	Cape Town	540
Cape Town	163	Channel Islands	390
,, Teleg. mat... ..	1,967	Christchurch	58
Colombo	147	Christiania. Teleg. wire ..	50
Copenhagen. Teleg. cable ..	223	Colombo	141
Durban	752	Copenhagen	220
East London. Teleg. mat. ..	555	Durban	540
Fremantle	375	Fremantle	13
Gibraltar. Teleg. mat.	10	Gibraltar	12
Halifax	26	Hobart	192
Hamburg. Teleg. mat.	500	Hong Kong	752
Hong Kong	1,037	Madras	2,750
Liban. Teleg. apparatus ..	940	Melbourne. Elec. cables ..	70
Melbourne	75	Nagasaki. Teleg. mat.	3,000
,, Teleg. mat.	909	Otago	15,000
Odesa. Teleg. mat.	200	Penang	20
Ostend	442	Port Elizabeth	24
Otago	46	Port Said	100
Port Elizabeth	38	Progreso	35
Port Said	21	Reval	360
Rangoon	475	St. Petersburg. Teleg. mat. ..	100
Rio Janeiro	36	Shanghai	168
,, Teleg. mat. ..	563	Sydney	197
Rosario	577	Syra	35
,, Teleg. mat.	309	Toronto	183
Santos	417	Wellington	50
Shanghai	286	Yokohama	279
Singapore	315		
Stockholm. Teleg. mat. ..	232		
Sydney	822		
,, Teleg. mat.	1,733		
Wellington	51		
Yokohama	30		
Total ..	£16,660	Total ..	£26,115

Foreign Goods Transhipped.

Christchurch. Elec. mat.	Value £20

Bankruptcy Proceedings.—At a sitting of the London Bankruptcy Court, held on Thursday last week, before Mr. Registrar Linklater, Frank Walter Henton, electrical engineer, trading at 24, King William Street, Strand, as F. W. Henton & Co., applied for an order of discharge. The Official Receiver (Mr. G. W. Chapman) reported that the bankrupt failed in August, 1898, with ranking liabilities £1,070, and assets that had realised £2 15s. 5d. He began business on his own account in October, 1891, but was unsuccessful, and losing his capital, abandoned the business after 9 or 10 months. In the autumn of 1893, he contracted to furnish an electrical equipment for the stage of the Alhambra Theatre, for which purpose he took premises in King William Street, Strand, where he also carried on a general business. The failure was ascribed to losses on contracts, both in connection with the Alhambra Theatre and for illuminations at the time of the 1897 Jubilee. The discharge was suspended for a further period of two years on the grounds of (1) insufficiency of assets to pay 10s. in £ to the creditors; (2) imperfect books; (3) trading with knowledge of insolvency.

Dissolution.—Messrs. J. T. Tattersall and S. Smith (Tattersall & Smith, electrical engineers, of Morecambe, Lancaster and Middlesbrough), have dissolved partnership. Mr. Tattersall continues the business under the old style.

Catalogues.—The Forest City Electric Company, of Manchester, has sent us a copy of its new catalogue of dies for "drop forged" commutator segments, from which we observe that the company is prepared to furnish most of the standard segments for tramway motors, as well as for generators. Readers who obtain this catalogue will be interested in pages 37, 38 and 39, as they show how one manufacturer of electrical machinery has standardised his commutators. The 15 different segments shown on these three pages are used in commutators of four different diameters only, which means only four different sizes of insulating rings, as well as appliances for assembling and finishing.

Messrs. Mather & Platt, Limited, of Manchester, have issued a pamphlet which we have no doubt will be very serviceable just now when the electric motor is coming so much into evidence for factory driving. The pamphlet, which is got up in that excellent style which characterises all of their publications, is entitled "Electrically-driven Machinery," and contains a brief recital of the advantages of the electric motor, and shows such in use for driving machinery of different kinds, such as calico-printing machinery, hoists, travellers, circular saws, drills, pumps, conveyors, shunting locomotives, &c., &c. The way in which the motor lends itself to fixing in almost any position is shown in some of the pictures, the positions illustrated being—raised on a platform, driving a line shaft by belt, placed overhead, fixed against a column, &c.

The British Schuckert Electric Company, Limited, of Clun House, has issued a new price list (illustrated) of its continuous current dynamos.

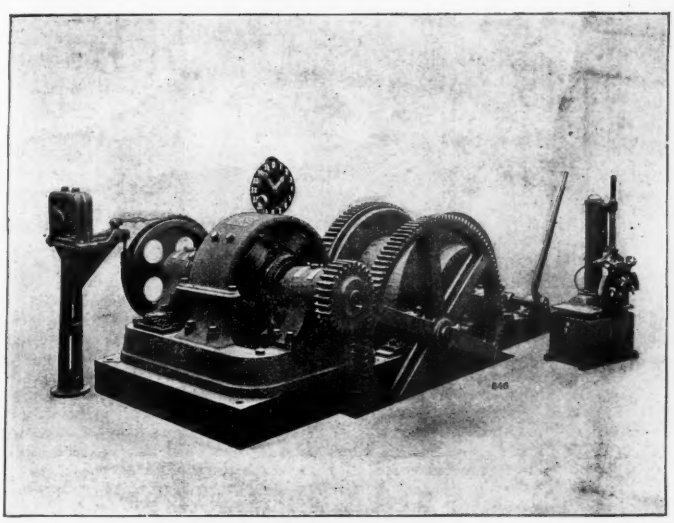
From the Tibbington Collieries and Brick Works, Limited, of Tipton, Staffordshire, we have received an illustrated list of fire bricks for boiler seatings and flue coverings.

Dick's Asbestos Company and the Eagle Non-conducting Cement Company have issued a very neat wall calendar.

The Edison & Swan United E. L. Company are sending handy glass paperweights out to their customers.

Exhibition.—The Electrical Exhibition at the Royal Aquarium, Westminster, opened on Monday, 16th inst., and continues until January 25th.

Electric Winding Gear.—The illustration represents an electric winding gear which has just been supplied by Messrs. Ernest Scott & Mountain, Limited, electrical and general engineers, of Newcastle-on-Tyne, England, to the Heckmondwike Collieries, for winding from a staple about 100 yards deep. The winding gear consists of one of Scott & Mountain's 4-pole open-type electric motors capable of working up to 50 E.H.P. at a speed of about 600 r.p.m., and at the end of the motor shaft an automatic electric brake is fitted which sustains the load immediately the current is switched off, the coils of the electro-magnet being in circuit with the armature of the motor. Immediately the current is switched on to the motor the armature is attracted by the electro-magnet and releases the brake wheel The motor drives through a train of gearing (the first motion pinion being forged steel machine-cut), into a machine-cut cast-iron spur wheel, which is supported by a countershaft on which a pinion is carried gearing into a spur wheel on the drum shaft. The drum is 3 ft. 6 in. diameter by 2 ft. wide, lagged with elm with strong cast-iron sides, and a brake strap being fitted on one side which is controlled by the attendant. An indicator is provided which shows the position of the cages in the shaft; this is driven by machine-cut wheels from the shaft. The whole gearing is mounted upon a cast-iron bedplate made in sections for getting down the pit and into position by the staple. The electric motor on the winding gear is controlled by a special type of liquid reversing and regulating switch. The dynamo supplying current to the winding gear is also of Messrs. Scott and Mountain's multipolar type giving an output of 50 KW. maximum and is driven at bank by a horizontal engine, the current being taken through cables 1,030 yards in length down to the winding gear motor. The firm makes winding gears of this type in all sizes.



Electric Winding Gear.

Books Received.—"An Improved Mode of Procedure for the Grant of Letters Patent," by G. G. M. Hardingham London: The Bedford Press. 1901.

"The Centrifugal Pump, Turbines and Water Motors," by C. H. Innes. Manchester: The Technical Publishing Company, Limited. 1901. Third edition, 4s. 6d. net.

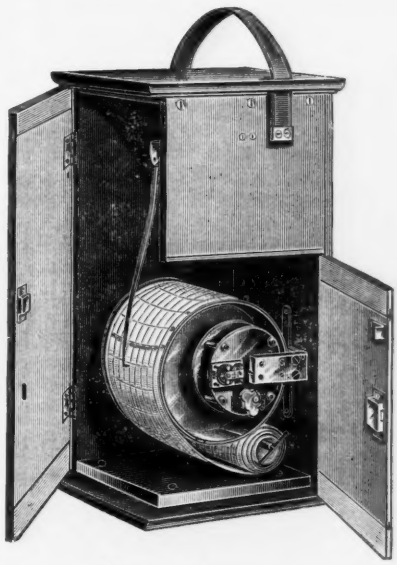
"The Practical Electrician's Pocket Book for 1902." Edited by H. T. Crewe. London: S. Rentell & Co., Limited. 1s.

"Bulletin of the United States Fish Commission." Vol. xix. for 1899. Washington: Government Printing Office.

"Proceedings of the Physical Society of London." Vol. xvii., Part vii. London: Taylor & Francis. 1901.

"Annuaire pour l'an, 1902." Paris: Gauthier-Villars. 1 fr. 50 c.

Tramcar Recorders.—We alluded in our last issue (page 1008) to Messrs. Everett, Edgcumbe & Co.'s new recording instruments, which have been specially designed for recording the power taken by tramcars. We are now able to give an illustration showing a recording ammeter of this type. Among its important features are the special elastic couplings supporting the movement inside the outer portable case, whereby the vibration of the car is effectually damped out. This not only protects the instrument from damage, but at the same time ensures accurate readings even under trying circumstances. It should be mentioned that these instruments are of the moving coil type, and besides being absolutely dead-beat, are unaffected by being placed near the motors of the car. The instrument illustrated is fitted with a "continuous roll" chart, but all these recorders are also adapted for single sheet charts, which, in many cases, are preferable. We understand that Messrs. Everett, Edgcumbe & Co. are supplying these to several electric tramway companies.



Tramcar Recorder.

Electrical Developments in Cleveland.—The *Leeds Mercury* says that, at an estimated expenditure of £70,000, Messrs. Bolckow, Vaughan & Co. are installing electricity as motive power for the greater portion of their machinery at the Cleveland Steel Works, Middlesbrough. At the Normanby Ironworks, near Middlesbrough, an electrical hoist (the first of its kind in Cleveland) is now being erected for the purpose of conveying the materials to the top of the new furnaces which have recently been blown-in at Normanby, and are now producing 1,000 tons of iron per week.

Electricity in Collieries.—An installation of electrically-propelled coal wagons is being carried out in the collieries of the Société des Charbonnages de Grand-Conty, Belgium.

The European Maguire Works.—The *Bury Guardian* says that satisfactory progress is being made with the equipment of the works at Elton Fold, which are about to be opened by the European Maguire Electrical Manufacturing Company, Limited, and it is anticipated that work will be commenced in earnest early in the New Year, as the firm have to commence the delivery of goods by March. The first order which will be dealt with at Bury will probably be the contract for trucks for the Great Northern Railway Company, which has been secured by this firm. The amount of the contract is £25,000, and it will take some eight months to complete. Another matter of interest to Bury people is the fact that negotiations are nearly completed for the making, at Bury, of the new Crawford-Voelker electric glow lamp, for the North of England, the European Maguire Company having practically obtained the rights to make the lamp.

Concert.—The Incandescent Electric Lamp Company's employés held their annual smoker in Brook Green Works on Saturday evening, 14th inst.

Christmas Holidays.—The Langdon-Davies Electric Motor Company, Limited, will close their works and offices from Monday, December 23rd, to Saturday, December 28th, inclusive. A small staff will remain to deal with urgent correspondence. The Electric Construction Company, of Wolverhampton, will close its works from midday on Tuesday, December 24th, to Saturday, December 28th inclusive.

Edinburgh.—The contract for the electric lighting and heating of the Edinburgh Museum, has been placed in the hands of the National Electric Wiring Company, Limited. We understand that the Edinburgh Museum is next in importance and size to the British Museum, London. The contract for the electric lighting of the War Department Buildings, Millbank, has also been secured by this company.

E.L.B.—The Electric Lighting Boards Company announce that their French representatives were able at three days' notice to instal the entire electric lighting system of the numerous stalls at the great Automobile Exhibition in the Grand Palais of the Champs Elysèe, the number of lights applied in this limited time being no less than 6,000.

Fires.—Damage by fire to the amount of £800 was caused at the works of Messrs. F. Jones & Co., electrical engineers, Seller Street, Chester, on Monday night, last week.

We learn that on Wednesday morning, the premises of Messrs. Gent & Co., electrical engineers, of Leicester, were destroyed by fire. It seems that the fire broke out in an insulated wire factory, and the whole buildings were gutted, the loss being £15,000.

Faraday House.—An important change in the commencement of the Session will come into operation at the Electrical Standardising, Testing and Training Institution next year, the

session, *i.e.*, a new course of instruction, commencing on Monday, January 13th, 1902, instead of in the middle of February as heretofore. The entrance examination will be held on Wednesday, January 8th, at 11 o'clock.

Foreign Electrical Imports.—The value of the foreign electrical goods and apparatus imported into this country during last month is returned at £58,029, as contrasted with the £52,931 in October last, and £149,537 in November, 1900. So far as the year has gone, there has been a falling off in the imports, the returns for the 11 months ending with November last showing a total of only £794,810, as compared with £1,118,760 in the first 11 months of 1900

The Glasgow Exhibition.—A local paper says that the Corporation have bought at £10 10s. each from Messrs. W. Macfarlane and Co., the 57 electric light pillars which they had in the Exhibition grounds. They have also accepted the offer of the Brockie-Pell Arc Lamp, Limited, to sell 200 of their exhibition double carbon lamps, similar to those now burning in Springburn Road, at £8 3s. each, they taking back the 67 single carbon lamps supplied to the Corporation some time ago, and allowing £5 each for them.

Izaacson v. New Grand, Clapham Junction, Limited.—This case came before Judge Horton Smith, K.C., and a jury, in the Westminster County Court on Monday, the plaintiffs being Alexander and Annie Izaacson, who sought to recover damages for the loss of their son, S. V. Lee Izaacson, through alleged defective plant on which he was at work for the defendant company when he was killed. Mr. Watson Moyses was counsel for the plaintiffs, and Mr. Minton Senhouse for the defendants.

Mr. Moyses opined that the action was brought under the Employers' Liability Act, 1880, and Lord Campbell's Act, 1846, the latter being incorporated in the former. Plaintiffs sought to recover damages for the loss of their son who met with his death in a horrible manner by being scalded to death at the New Grand Theatre of Varieties, Clapham Junction, where he had been employed as an engineer for some four months, by stepping suddenly into a sump, not far from the engine which generated the electric light for the building. It was full of scalding water, or steam, and had no cover on. It was too close to the boiler and not properly protected by the person in charge. Deceased was a splendid specimen of humanity, was 23 years of age, and held 23 certificates from the Goldsmith's Institute and had won two L.C.C. scholarships for proficiency in various branches of electricity and chemistry. He was paid £2 2s. a week as wages and £1 10s. a week overtime, but under the Employers' Liability Act, the maximum that could be recovered was three years' actual wages which came to £327 12s. On July 31st he was trying to remedy a defect in the plant when the accident occurred by his falling into this sump, which was a death trap if ever there was one.

The plaintiffs gave evidence as to their pecuniary loss.

Mr. J. Owner, one of H.M. Inspectors of Factories, was called by Mr. Moyses, but Mr. Senhouse objected to his evidence on the ground that this was not a factory. Mr. Owner: This is a factory. Mr. Senhouse: Excuse me, electrical stations are not factories under the Factory Acts. There is a new Act coming in in January under which they are made factories. Even if it was a factory it would not apply to this sump which is out in the yard. The issue here is for the jury to say whether there was negligence or not. I object to the witness giving expert evidence.

Mr. Owner said he attended the inquest in consequence of receiving a wire at the Home Office from the Coroner. Apart from his official capacity as a Factory Inspector he had a knowledge of machinery and engineering. He made the plan produced of the *locus in quô* to scale. Did not make the plan for the plaintiffs. He attended on a subpœna and had declined to give a proof of his evidence. The sump was 4 ft. by 2 ft. and 3 ft. 9 in. deep. There was an earthenware 4-in. outlet pipe 2 ft. 6 in. from the bottom, and there was an inlet from the boiler 3 in. below that level on the opposite side. Attended on August 6th at the premises for the purposes of the inquest. The cover was an ordinary drain inspection cover, what was known as an air-tight inspection cover, and the place to receive it was 18 in. by 24 in. There was no grating; the cover would be blown off in the event of a great rush of steam from the boiler.

Mr. Moyses pressed for the admittance of expert evidence from this witness. During the 20 years he had been appearing in these cases he had never met with such an objection, and it astounded him.

The evidence was admitted.

Mr. Owner said, in his opinion, from his knowledge of machinery and engineering, the *locus in quo* was unsafe.—Cross-examined: Did not know whether there was a regular inspection by the L.C.C. electrical department or whether the Battersea Borough Council inspected the buildings. Did not read a report of the inquest in the newspapers.

Mr. Fredk. W. Rayner, Assoc.Inst.E.E., said he was manager in charge of the electrical installations at the various theatres of the defendant company, and had 20 years' experience. He employed deceased on behalf of the company. He was a good fitter with a sound electrical training. On July 31st the feed water had failed through the tube becoming blocked, and deceased cleared it. He afterwards inserted a longer tube to make doubly sure that it was clear, one that would go right through. He satisfied himself, and witness was leaving when he heard a cry, and H oper, the stoker, said Izaacson was in the sump. It was full of water as it did not get away properly, and sometimes overflowed and floated off the cover if it was put on. It had to be bailed out with buckets to prevent flooding. The sump was to cool the water as there was an objection to the hot water going into the sewers. When witness had the sump cleared out about three weeks before the accident he found a broken cover there. The one for use was cracked. There was a trench 14 ft. wide and 12 ft. 6 in. deep round the engine room, and the rail thrown up prevented one of the boiler-house doors from being opened, and that made it necessary to pass very close to the sump to pass in and out The trench was made to try and do away with the vibration caused to the adjoining property by the machinery. There might have been a screw-down cover, or checker plate, over the sump opening, or a grating. The directors of the defendant company, inspected the sump after the accident. He gave evidence at the inquest, and shortly after was discharged. Cross-examined: Had no explanation as to why he was discharged. His duties were to travel round and see after electrical matters at the various theatres of the company. He usually stopped at a theatre until the engines were started. There was a boiler attendant at the New Grand. Izaacson was in charge when witness was not there. In blowing down some 60 or 70 lbs. of steam, the cover would be raised by the pressure. There was nothing wrong in taking the cover off. Re-examined: The sump was not properly constructed, or the water would have run off.

Mr. Charles Cooper, consulting engineer, said he had many appointments, had been chief engineer in the Spanish Navy, and had over 40 years' experience in boiler work. He inspected this sump and found it dangerously constructed. If the cover was closed there would be no means of properly blowing down.

Frederick Hooper, boiler attendant at the New Grand, said the sump was unsafe. Cross examined: In his opinion Izaacson met his death by a pure accident. He stepped back and fell in. Re-examined: It was an act of forgetfulness that might happen to anybody.

Mr. Senhouse contended deceased was not a workman within the meaning of the E.L. Act, that there was no negligence on anyone's part, no defect in the plant, and when the accident happened Rayner was not the person in charge. On the first point he read from the Act the list of persons it applied to, and contended that this young man with his 25 certificates and scholarships could not be regarded as any one of them. He was highly skilled.

Mr. Moyses contended he came within the Act as a journeyman, and being talented did not prevent him from being a workman. He was an engineer, and he (Mr Moyses) had applied for hundreds of engineers in cases under the Act. He was exercised in manual labour when the accident occurred.

The Judge said it was not part of his duties. If he (the Judge) had done it that would not make him a workman. His duties were not to superintend when Rayner left. He had satisfied himself about the tube, and Rayner was leaving when he was called back owing to the accident. There was no case to go to the jury as he held deceased was not a workman. He found for the defendants.

Mr. Moyses said he should take the earliest opportunity of getting that decision reviewed. He formally applied to show he had not waived it for an award under the Workmen's Compensation Act, but at the same time asked for the hearing to be postponed.

Mr. Senhouse submitted the decision must be given at once, and that deceased was not a workman under the Workmen's Compensation Act.

Mr. Moyses submitted an electrical station was a factory. Electricity was produced by mechanical power, and he asked to be allowed to call evidence.

Mr. Senhouse objected on the ground that there was no power to produce evidence in an arbitration under the Workmen's Compensation Act following a failure under the Electric Lighting Act. The same evidence applied.

The Judge was of the same opinion, but if Mr. Senhouse would withdraw his objection, he would allow evidence to be given.

Mr. Owner, re-called, deposed that in his opinion, electrical stations were factories, and they were so regarded by the Factory Department of the Home Office.

Mr. Moyses: Electricity is made there?

Mr. Owner: Yes.

The Judge: I have friends in the country who have their own electrical plant, but their houses are not factories. Electricity is only generated at this theatre for themselves.

Mr. Moyses: They manufacture a commercial commodity, and that makes it a factory.

Mr. Senhouse: Electricity is not made, there is merely a change of force.

The Judge held it was not a factory, and that deceased was not a workman within the meaning of this Act either, therefore the whole action would be dismissed with costs.

Mr. Moyses intimated that there would be an appeal.

Mansion House Charge. — We understand that at the Mansion House on Tuesday last week, before Mr. Alderman Alliston, Wm. Geo. Bradley, assistant wireman, and Abraham Goldsmith, electrician, of 237, Whitechapel Road, were charged on remand—the former with obtaining goods by means of forged orders from the General Electric Company, and the latter for feloniously receiving the same, well knowing them to have been fraudulently obtained. The prosecution was now undertaken by Messrs. G. Weston & Co., in lieu of the General Electric Company, inasmuch as it was on order forms stolen from Messrs. Weston that the goods were obtained. After a prolonged hearing the Alderman discharged Goldsmith. Bradley he committed for trial on the charge of forgery.

The Process Year Book (1901—1902).—This beautiful annual has again made its appearance, and is replete with examples and information respecting the various engraving processes used in book and newspaper illustration. In addition to black and white

engraving processes, colour work comes in for a good share of attention, and the examples given show effects both tender and true. It is published by Messrs. A. W. Penrose & Co., 109, Farringdon Road, London.

Southampton Cranes. — At the Town Quay, Southampton, on Tuesday morning, an official trial of a new electric travelling crane was made in the presence of Aldermen Bone and Tilling, Mr. Walter Bowyer (superintendent to the Harbour Board), Mr. J. G. W. Aldridge (electrical engineer), Mr. Cecil Sainsbury (representing the builders, Messrs. Stothert & Pitt, Limited, Bath), and others. This is the seventh electric crane that the Board has placed on the Town Quay for handling the very large and increasing traffic with which it has to deal. The electric crane just completed is for dealing with light loads up to 30 cwts. at 225 ft. per minute and lighter loads at a still higher speed. The cranes previously supplied have been placed on high gantries to allow the traffic to pass through, but the present crane runs on an ordinary truck which is fitted with buffers and runs on 4 ft. 8½ in. gauge, so that it can be transferred to any part of the quay. The radius is 30 ft. The current is brought to the crane by flexible cables connected to junction boxes placed at convenient positions. The crane has lifting and slewing motions worked by separate electric motors. The lifting motion is actuated by a patented arrangement on a plan devised by Mr. Aldridge, the electrical engineer to the Harbour Board, in conjunction with Messrs. Stothert & Pitt, Limited, by which the barrel is connected or disconnected from the lifting shaft by the same handle that works the lifting motor, the load being lowered under the control of a mechanical brake. This arrangement not only greatly adds to the speed of the crane, but also conduces to economy of current—two points of great importance when discharging cargo. The slewing gear is actuated by a separate motor. The crane is housed in with a most complete crane house, the working handles being placed close to a large window, so that the driver can see his work; and the whole arrangements are marked by great simplicity and compactness. There are incandescent lights in the crane house and on the jib of the crane. The revolving collector for taking the current from the centre pin of the crane is also a patent of Mr Aldridge's. The builders have in course of construction no less than 80 electrical cranes for various harbour authorities.

Telephonic Bell-Push Syndicate, Limited. — In connection with the winding-up of the Telephone Bell-Push Syndicate, Limited, Mr. Clauson moved on Wednesday, before Mr. Justice Wright, in the Companies Winding-up Court, for a stay of proceedings. The Official Receiver, he said, was entitled to certain fees and expenses. He had a balance in hand, but certain secured creditors required to be paid at once, whilst the other creditors had agreed to postpone their payments for three months. His Lordship asked if it was proposed to resuscitate the company. Mr. Clauson said it was. It had sold one patent, and might sell others if the proceedings were stayed. The proposal was to pay the Official Receiver his fees and expenses, and leave the balance over until it was seen what could be done in the way of selling the company's patents. Mr. Chubb said the Official Receiver left the matter entirely in his Lordship's hands. His Lordship said he saw no objection to granting the application. Proceedings stayed accordingly.

Trade Announcements.—The Liverpool Electric Cable Company, Limited, have commenced business at 292, Vauxhall Road, Liverpool, as manufacturers of electrical wires and cables to any specification. Their principal manufactures will be vulcanised rubber, electric light cables, pure rubber insulated cables, aerial cables, flexible cords and dynamo wires. They have put down a complete plant, having all the latest improvements. The rubber used is manufactured on the premises, and the company are enabled to guarantee the quality of their cables. A new price list is now ready. Mr. Robert Taylor, who takes charge of the works, has had more than 25 years' experience in the manufacture of rubber and electric light cables, and was with Messrs. W. T. Glover and Co., of Salford, Manchester, and their successors, when they were converted into a limited liability company, for a period of 11 years, during seven of which he was works manager. Mr. Samuel Hartford, who takes charge of the commercial part of the business, was also with Messrs. Glover & Co. for 15 years, and notifies us that he has transferred his business and services to the company, having been appointed its secretary and commercial manager.

The name of Rosling, Appleby & Fynn, Limited, has been altered to Rosling & Fynn, Limited.

Troughing.—We understand that Messrs. Rowland, Carr & Co., of 6 and 8, Lime Street Square, E.C., have been entrusted with the whole of the cast-iron troughing for the Manchester Corporation, through Messrs. W. T. Glover & Co., Limited. The same firm have also executed the whole of the steel troughing for the trunk main of the Charing Cross and City Electric Lighting Company, Limited, and have supplied through their principals, the Asphaltic Limestone Concrete Company, Limited, of Birmingham, for whom they are sole agents, something like 2,600 tons of bitumen for the filling in of troughs. The Manchester contract for cast-iron troughing is one of the largest that has ever been given out for this class of work, being for over 100,000 yards.

What the British Consuls have to Say.—*Telephone Lines in Hong Kong*, Colonial Secretary J. H. Stewart Lockhart reports, were kept in good repair during 1900, but considerable expenditure was found to be necessary in the new territory, where most of the poles are of timber. The police station at San Tin was connected by telephone with Táipó, new switchboards were installed at the central and Tsim Shá Tsui police stations, whereby a great improvement was effected

Electric Light in Lagos. — In a report on the public works of Lagos, Assistant Colonial Secretary F. Bisset Archer states that "a great feature during the last two years has been the establishment of the electric light. All principal streets throughout Lagos are now efficiently lighted by means of 250-C.P. glow lamps. The light is kept burning from sunset to sunrise. All the principal Government buildings are connected, and it is hoped before very long to make arrangements for installing it in the houses of the mercantile community and others.

Telephone Service in Hungary.—Consul-General C. C. Thornton, reporting on the financial condition of Hungary, refers to the introduction of the telephone into the capital and the adjoining township of New Pest in 1880 under a system of licensing. He states that the license system was transformed in 1887 into a lease granted to private persons, but in 1897 the whole business was taken over and worked by the State; Parliament, on the motion of the Government, having authorised the acquisition of all existing telephonic wires.

ELECTRIC LIGHT AND POWER NOTES.

Aylesbury.—The D.C. has resolved to enter into an agreement with the North Metropolitan Electrical Power Distribution Company, Limited, to carry out the supply of electricity in the district under the Council's prov. order.

Ayr.—The T.C. has agreed that the charge for energy for motive power be for the first 500 units, 4d. per unit, reduced by a sliding scale to 2d. for 5,000 units per annum.

Bath.—The City Council has appointed Mr. Manville to report on the present condition and prospects of the electricity supply undertaking. Mr. Teague, the engineer, urges the necessity of prompt action to provide for next winter, and advocates the supply of energy to the Tramway Company as a means of effecting an economy.

Bedlingtonshire.—The D.C. has decided to agree to the terms of the Northern Counties Electric Supply Company for supplying electricity in the district.

Belfast.—A deputation representative of the electrical engineering and gas-fitting firms of the city has protested against the contemplated purchase of motors by the Corporation for letting out purposes, and also against the Corporation fitting up wires, &c. The deputation was of opinion that the Corporation should confine itself to supplying electricity.

Boston.—The Committee last week passed the following resolution:—"Having considered Mr. Adrian Collins's report, this Committee thinks it desirable to invite three or more constructive firms to submit schemes of public lighting, electric traction, and supply of motive power, with estimates, and that the said firms give alternative estimates showing terms upon which they would work the scheme put forward for a term of years, and the terms upon which the Corporation could acquire them."

Brynamman.—A meeting of ratepayers was held recently to consider the question of the lighting of the town, and a committee was appointed to take the matter in hand.

Cardiff.—A succession of mishaps led to a failure of the electricity supply for a short time last week.

Coventry.—The E.L. Committee has decided to change the frequency of the alternating current supply from 87 to 50 cycles per second in carrying out the extensions.

Dingwall.—Mr. Adams has laid before the T.C. a proposal to utilise the tidal current in the canal at Dingwall for the purpose of generating electricity. Mr. Adams's scheme contemplates 1,000 8-C.P. lamps, and the capital outlay is estimated at £4,000.

Dorking.—The U.D.C. has rescinded the resolution passed in November, 1900, agreeing to sell or transfer the electric lighting prov. order to a company.

Dumbarton.—The T.C. has resolved to apply for a prov. order for lighting the burgh with electricity.

Edinburgh.—Two unfortunate errors got into our note under this heading on 6th inst. We are informed by Mr. F. A. Newington, the resident electrical engineer, that the motors connected with the Corporation works amount to 2,445 H.P., not 8,443; also, the total costs per unit for the week ending November 21st were 1·866d., not ·866d. We regret the errors the more, seeing that if the figures had been correct they would have shown such a prosperous condition of affairs.

Elland.—Application has been made by the D.C. to the L.G.B. for sanction to borrow £16,000 to provide an electric installation and refuse destructor.

Epsom.—The D.C.'s electric lighting works were opened on the 9th inst. The undertaking starts with applications for 1,050 lamps for private consumers. The generating station is fitted with two 150-H.P. boilers and generating sets to give 35 and 75 KW.

respectively, working at 460 volts on the three-wire system. Mr. Foster has been appointed resident electrical engineer, and the consulting engineer is Mr. Hawtayne.

Frinton.—The U.D.C. has conditionally approved of the Frinton Electric Company's application for a prov. order.

Gillingham.—The D.C. has decided to apply for a prov. order to supply electricity in the district.

Glasgow.—The electric light pillars—57 in number—displayed by Messrs. W. Macfarlane & Company, Saracen Foundry, in the Exhibition grounds have been purchased by the Corporation at £10 10s. each. An offer of the Brockie-Pell Arc Lamp, Limited, of 200 of their Exhibition double carbon lamps at £3 3s. each has also been accepted by the Corporation.

London.—City.—The negotiations between a Special Committee of the City Corporation and the City Company, from which so much was expected, have, unfortunately, collapsed. It was arranged that the Committee should report to the effect that all the old contracts should be terminated at once, that all litigation should cease, and that a new contract for the lighting of the principal thoroughfares should be entered upon. The company was to be freed from all liability regarding the side streets. At the meeting of the Corporation on Thursday last week, the Committee was to have presented a report to this effect, but at the last moment a communication was received from the company's solicitors which completely altered the position; the company refused to agree to the cancellation of the contracts. Hence the Committee reported that the negotiations were broken off, and asked to be discharged. The Corporation agreed, and referred the question once more to the Streets Committee. The company denies that it ever consented to abandon the contracts, while the Committee is equally positive to the contrary, and the matter is practically *in statu quo ante*.

L.C.C. It was stated by the Parliamentary Committee that the Bill to deal with the purchase of undertakings for the supply of electricity in London, in cases where a company supplied electricity in more than one metropolitan borough, provided for the purchase of the undertakings by the Councils of such boroughs in combination, or by the London County Council, with the consent of such Borough Councils, or of a majority of them. It would enable authorities to carry on the undertakings, and empower the County Council to transfer any part of an enterprise to the authority for the area such part supplied. The Bill also proposed to authorise the County Council to supply electricity in bulk, and to substitute 42 years from August 26th, 1889, as the period of purchase, in the place of the period named in Sec. 2 of the Electric Lighting Act, 1888. The Council approved the Bill without discussion.

The Council, at its meeting on Tuesday, sanctioned or advanced the following electric lighting loans:—Battersea Borough Council, £10,000; Hackney Council, £35,800, for lighting and refuse destructor; and the St. Pancras Council, £18,210, for buildings, mains, meters, and machinery.

Manchester.—At the close of a long meeting last week, the Electricity Committee of the Corporation appointed a committee, with the Lord Mayor as its chairman, to inquire into certain statements which had been made affecting a member of the committee, who, it is alleged, had made use of the services of the officials of the department for the purpose of his own private business.

Middlesborough.—The Council's consulting electrical engineer, Mr. Hammond, recently reported that the load was nearly up to the limit of their power of supply, and recommended that £7,500 should be expended in additional plant. The T.C. is taking steps to this end.

Mitchelstown.—The R.D.C. has resolved to apply for a loan of £2,000 for electric lighting.

Morecambe.—Mr. H. P. Boulnois recently held an inquiry of the L.G.B. into the application of the U.D.C. to borrow £5,000 for electric lighting excess expenditure.

Otley.—The D.C. has decided to apply for a prov. order for electric lighting.

Peterborough.—The Electricity Committee has recommended the Corporation to expend £10,000 on extensions of the electricity works.

Paisley.—In connection with the extension of the electric lighting works in order to supply the tramways with energy, the T.C. has resolved to apply for a prov. order for further borrowing powers to the extent of £30,000.

Perth.—There are now 13,457 lamps connected in Perth, within six months of the introduction of the electric light.

Russia.—A company has just been formed in Brussels with a capital of £128,000, to be known as La Compagnie d'Electricité du Midi de la Russie, to establish and work a central electric lighting station at Rostov on the Don.

Spain.—A large central station, known as the "Electra Irati," has just been completed at Oroz Betelu. Water-power is utilised, the plant comprising two sets of 450 H.P. turbines and dynamos. The current will be supplied for lighting purposes in the town of Oroz Betula, and to the Villara works, for power purposes, 300 H.P. A works at Pamplona has also contracted for 100 H.P. This town is 20 miles away, and the current before transmission will be transformed at the station up to a pressure of 20,000 volts—the highest pressure yet attempted in Spain.

Stamford.—The works now being erected consist of boiler house, engine room, and accumulator room. The boilers are by Messrs. Babcock & Wilcox, and are fitted with chain grate stokers driven by a motor; superheaters will also be added. Two Belliss engines coupled direct to Parker dynamos are being put down; each engine is capable of developing 135 B.H.P. with a steam pressure of 160 lbs. per sq. in. Provision is made for the addition of a larger set when required. A battery of accumulators is being supplied consisting of 260 cells, and having a capacity of 350 ampere-hours when discharging at 35 amperes. The system adopted is the three-wire continuous current, with a pressure of 240 volts at the lamps. The switchboard was made by Messrs. Kelvin & James White, of Glasgow. The first portion of the cables will be laid by Messrs. Callender, on the solid system, and it is hoped that the supply will be commenced in February. The whole of the work is being carried out by the Urban Electric Supply Company, under the supervision of their resident engineer, Mr. W. E. Milns. Messrs. Edmundsons are the contractors.

Sunderland.—Some time ago the Tramways Committee of the Corporation applied to the E.L. Committee for a reduction of the price of energy supplied to them for tramway purposes. Mr. Snell, the electrical engineer, drew up a report showing the charges made in other towns, and last week it was decided that the Committee could not reduce the price of 2d. per unit now charged. The report stated that the Committee had lost considerably last year on the tramways, the actual cost for electricity for the trams being 4·11d. per unit and the average charge only 2·33d.

Surbiton.—Recent proceedings of the District Council savour of Gilbert and Sullivan's operas, or of the story of Dr. Jekyll and Mr. Hyde. Briefly, the E.L. Committee elected a Mr. Shaw to the position of chairman, knowing that Mr. Shaw was opposed to the scheme. The latter then presided at a meeting of ratepayers called to protest against the Council's electric light scheme! Naturally, the Committee passed a resolution of want of confidence; Mr. Shaw resigned, and afterwards tried to get the report of the Committee rejected, but without success.

Swansea.—Mr. Chamen, electrical engineer to the Glasgow Corporation, who had been called in to report on the present cost to the Harbour Trust of lighting the docks, reported that the cost to the Trust, including maintenance, was 1·577d. per unit. Mr. Prussman stated that the generation of electricity at the docks could be done by the Corporation at 1d. per unit, provided it was supplied in bulk of at least 300,000 units per annum. With maintenance, Mr. Prussman expressed the opinion that 1½d. per unit would be the very least it could be done for, and probably it would be more. It was decided to offer the Harbour Trust the necessary lighting at 1½d. per unit on a minimum quantity of 300,000 units a year.

Swindon.—At a meeting of the T.C. last week the town clerk reported the receipt of the sanction of the Local Government Board to the borrowing of £31,000 for electric lighting purposes. With respect to the post of clerk of works, for the erection of the electricity works buildings, it was decided to select three or more applicants to appear before the Committee, and after the interview Mr. J. Fitter, of Tottenham, was appointed at a salary of £3 3s. per week. The question of the construction of the tramways was referred to a sub-committee to confer with the electrical engineers (Messrs. Lacey & Co.) and report.

Swinton and Pendlebury.—The U.D.C. has appointed Mr. Wordingham consulting engineer to the Council.

Waterford.—The Corporation has deferred consideration of the electric lighting scheme for six months.

Wellingborough.—The T.C. has decided to apply to the L.G.B. for sanction to a loan for establishing electric lighting works.

Yarmouth.—The electric light receipts for the September quarter were £2,301 12s. 9d. After meeting the cost of production and paying £775 as interest and sinking fund, there was a surplus of £237 6s. 4½d. on the quarter. There are now 568 customers with 27,325 lamps. The quantity of electricity sold was 100,967 units.

ELECTRIC TRACTION NOTES.

Italy.—In a speech delivered by the Italian Premier, M. Zanardelli, on Friday last, he stated that as soon as the Chamber re-assembled he intended, without having recourse to private commission, to place the Rome-Naples electric railway project before the House for approval. The project stipulates for the accomplishment of the journey between the two cities in 2½ hours.

Last week the official trial of the high-speed electric railway between Milan and Varese was made and a speed of 90 kilometres (54 miles) per hour obtained. The train was composed of two elegant 1st class carriages.

Isleworth.—The advent of the L.U.T. trams in this district has had the effect of waking up the local shopkeepers on the line of route, many of whom are putting in new fronts and otherwise making a bold bid for popular patronage.

(*Continued on page* 1049.)

SPRAGUE MULTIPLE UNIT SYSTEM.

As Applied on the Boston Elevated Railway.

By FRANK J. SPRAGUE.

(*Continued from page* 972.)

Master Switch.

The master switch (fig. 10) is of the cylinder type. Right and left movement of a single detachable handle, normally

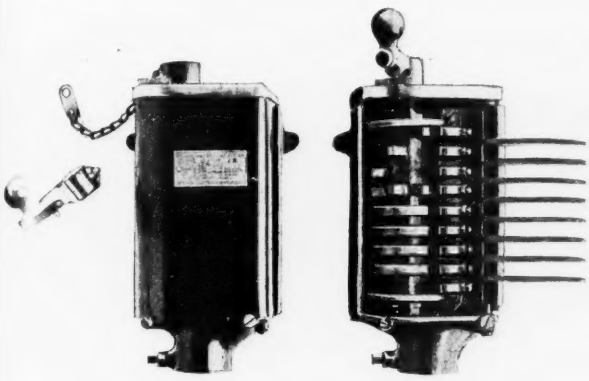


Fig. 10.

itched in a central position, produces ahead and reverse notion, and any desired variation of speed. Movement s opposed by a spring, which returns the handle to the entral or "off" position when released, and automatically uts off the main current. The cover is lined with mica, well lacquered, and is easily removable. The vulcabeston eparators are hinged to facilitate inspection. The switch is of such form and dimensions as not to restrict in any way he clear passageway across the car platform.

Train Line Coupler and Jumper.

The train line is a compound cable, each wire heavily insulated and tested at 4,000 volts, and the whole sheathed with a waterproof braid. The couplers (fig. 11) are iron shells enclosing a block of insulating material, which supports the split-spring terminals of the train wires. They are connected to the train line at junction boxes. The terminals are

Fig. 11.

separated by an insulating partition, and are well insulated. The couplers are shrouded, and are self-closing when not in use. The jumper, whose ends are constructed in a similar manner to the couplers, and have complementary female contacts, is reversible, and can be coupled in one plane only. Both the jumper and the coupler are connected to the cables permanently at the back, the intervening spaces being filled with insulating compound. Each conductor is insulated with rubber, and protected with braid of various colours to facilitate connections.

Relays, Automatic Stop, and Throttle.

The relays, automatic stop, and throttle (fig. 12) are mounted vertically upon a slate support, thoroughly insulated, and the contacts are well separated and rigidly secured. The coils are held firmly in place, and the plungers are positively guided. Platinum or silver tips are used for the throttle in order to require minimum attention and to ensure perfect contact. The bridging discs have universal adjustment and spring cushion. The protective fuses for the control circuits are carried by clips on the relay slate, which also carries for convenience the cut-out switches and part of the adjusting resistances.

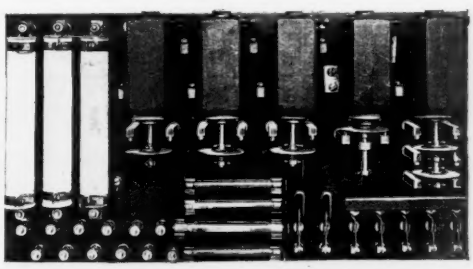


Fig. 12.

Resistances.

The grid resistances (fig. 13) for the main motors are of a special cast material, and are of a loop form to ensure flexibility. They are supported in longitudinal vertical planes on reconstructed granite insulators carried by angle irons for attachment to the car. Their construction permits of easy installation and repair, and secures reliable insulation as well as efficient radiation.

They are of sufficient section to withstand the shocks of service, and are of ample carrying capacity for the most extreme demands. All wire connections are made by means of bolted terminals.

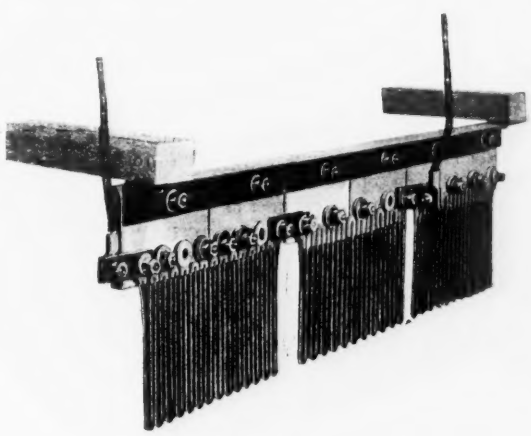


Fig. 13.

Weights of Equipments.

These are as follows :—

	lbs.
Two master controllers	45
One set relays, fuses, switches, &c.	96
One main controller and pilot motor	520
One reverser	560
Two junction boxes	6
Two couplers, with attached cables	25
One jumper	10
One set of grid resistances	660
One set of master switch and train cables	50
Total	1,972

Operation.

In the Boston equipment the motor switch is a separate piece of apparatus, operated when the rheostat switch is in an open circuit position, but for convenience of illustration and description it may be shown on the same cylinder as the rheostat. The typical circuits are arranged as shown in fig. 14, in which the various parts of a full equipment are indicated, as well as the inter-connection of circuits.

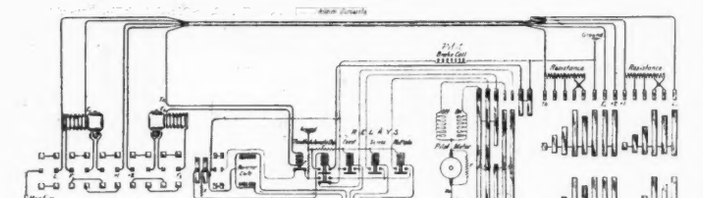


Fig. 14.

In ordinary operation the main motors are first thrown into series with a resistance, which is cut out until half the pressure is supplied to each motor, which is the half-speed combination. In going thence to full speed, the main circuits are first opened instantly at the main controller or reverser, or, if desired, progressively through resistances and independent main contacts. The motors are then thrown into parallel, with a resistance in circuit of about one-quarter that used in the first series position, which is progressively cut out until the motors have full pressure, and run at their full capacity and speed. The quartering of the resistances on the first position is effected by using independent resistances for each motor, throwing them in series and parallel relation the same as the motors and using the same progressive steps.

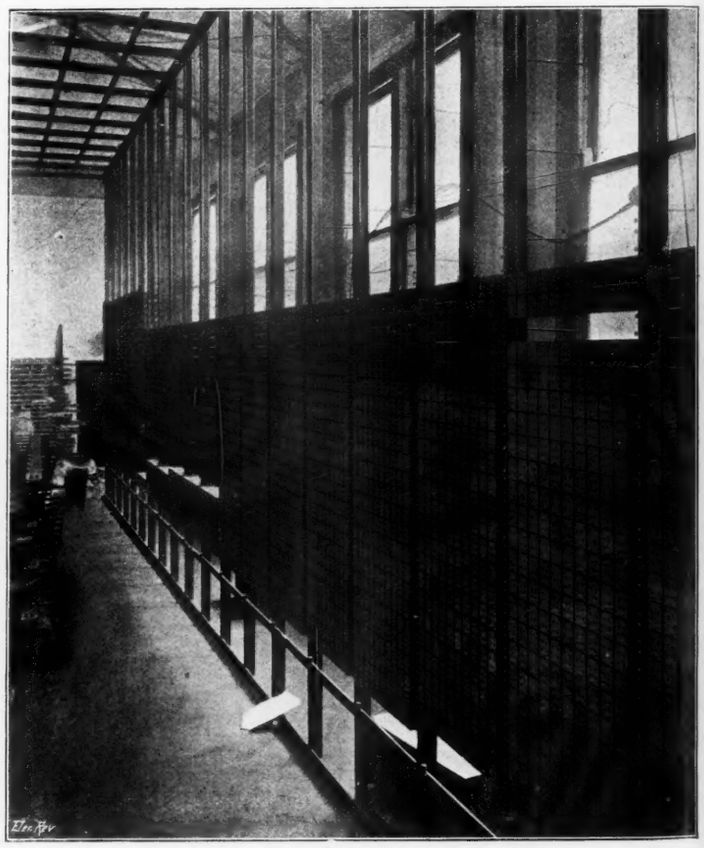
In any position of the controller the current can be cut off instantly by the reverser, which has also independent main-line contacts on the same spindle. Provision is made for dead-beat movement, and also for inter-connection of controlling circuits by contacts on the same cylinder as the main contacts. The circuit for the reverser passes through the automatic stop coil, and is completed through a by-pass on the controller in the first contact position, or through a contact made by the automatic, so that once opened it cannot be operated again unless the controller is in a safe position for the motors.

The cylinder of the main controller is driven with an intermittent motion by a pilot motor through a powerful locked spring, so that the armature of the pilot motor and the spindle of the cylinder do not move either in synchronism, or to an exactly like extent. This is necessary to ensure freedom from hot contacts and dragging of arcs.

The pilot motor is governed by five relays, called, respectively, the "coast," "series," and "multiple" relays, the "automatic stop" and the "throttle."

There are three ordinary running positions for a pair of railway motors; the coast or open circuit position, the series position, when the two motors are in series without any resistance in circuit, and the parallel position, when the two motors are independently across the line without any resistance. In addition, the motors can be run temporarily with more or less of the resistances in circuit for the purpose of switching. On heavy railroad work, such as on elevated and suburban roads, minor variation of running speed in either the series or multiple relation of the motors by the use of resistances is rarely practised, and is never necessary, save in starting. The apparatus is especially arranged to discourage any such variation of running speed.

The circuit which operates the pilot motor on each car is a purely local circuit, coming from the car shoes and returning to the track, just as the main circuit of the motor does. It is not connected to the train line or the master switches in any way. Its path is through the field magnets, brake and armature of the pilot motor, through the contacts of the coast, series, or multiple relays, and also through the contacts of the throttle and automatic stop. If either the throttle or the automatic is in an open circuit position, it is impossible for the pilot motor to move in one direction, and hence impossible for the controller to be advanced, although if in the advanced position it can be reversed. The circuits through the relay contacts and the pilot motor also pass through limit switches on the controller cylinder. If this control cylinder is in the "off" position, and the throttle and automatic stop are in the proper position, closing the coasting relay will not cause any movement whatever, but closing the series relay will allow the pilot, if otherwise uninterrupted, to move the controller to the series position, where it will automatically stop. In the same way closing the multiple relay will move the controller either from the coast or series position to full parallel, where it will be automatically stopped. Opening the throttle, however, will either arrest or retard the rotation of the pilot motor and the progression of the controller, and dropping



The Central Telephone Exchange.—View of Meter Rack.

the automatic by opening the reverser circuit will return the controller to open circuit or any other determined position, regardless of the motorman.

The throttle is operated automatically by the current in one of the motors, and serves a double purpose. It retards or stops the forward movement of the main controller at any desired current increment, and since it responds to a determined value of the current, it can become an automatic switch for providing a definite rate of acceleration. It does not prevent any desired slower rate of acceleration, or in any way remove from the motorman the positive operation of the main controller at will within the limits of safe and desirable current input.

The coast series and parallel relays are energised by platform-switch circuits, which terminate in the master switch. To this switch are brought also the terminal wires of the solenoids operating the reverser. Except as the motorman is limited by the automatic features, or hindered by circumstances which he cannot, and is not intended to control, all operation either of the particular car or the train is initiated at the master switch.

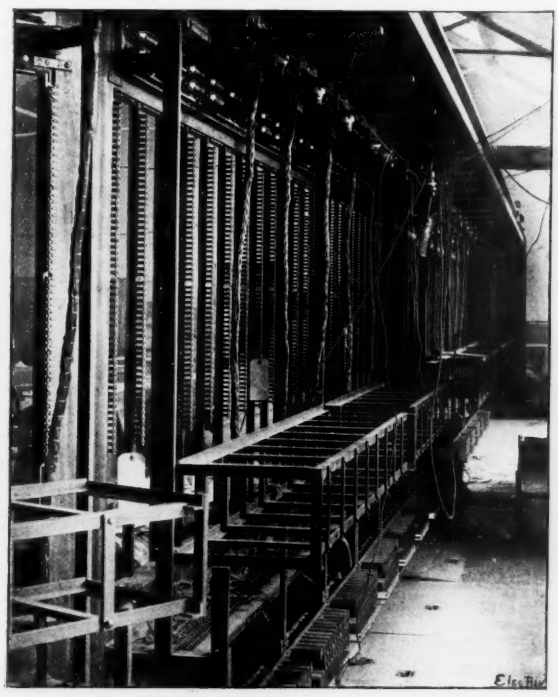
(To be continued.)

THE CENTRAL EXCHANGE OF THE LONDON POST OFFICE TELEPHONES.

(*Continued from page* 937.)

We may now proceed to describe the connections and the system of working.

At the subscribers' station there is a magneto-bell, a receiver and induction coil, a transmitter, and a 2-mfd. condenser. The connections of these are shown in the adjoining diagram. It will be seen that when the receiver is on the hook, the receiver and transmitter are cut out of circuit, and the subscriber's circuit is open to direct currents. The lines are, however, bridged by the magneto-bell in series



Back View of Local Board, under Construction.

with the condenser; consequently the circuit is complete for alternating currents, and thus the subscriber can be rung up from the exchange.

Following the lines to the exchange, we see that a constant potential difference of 20 volts is maintained between them by means of a storage battery. When the subscriber takes his receiver from the hook, his speaking circuits are closed by the switch-hook, allowing a current to flow through the transmitter and the primary of the induction coil; the small shunt current through the receiver, the secondary coil, and the magneto bell is negligible.

At the exchange, this current passes to one of the lines through the line relay, of 60ω resistance; this switches on the line indicator calling lamp across a pressure of 24 volts, causing

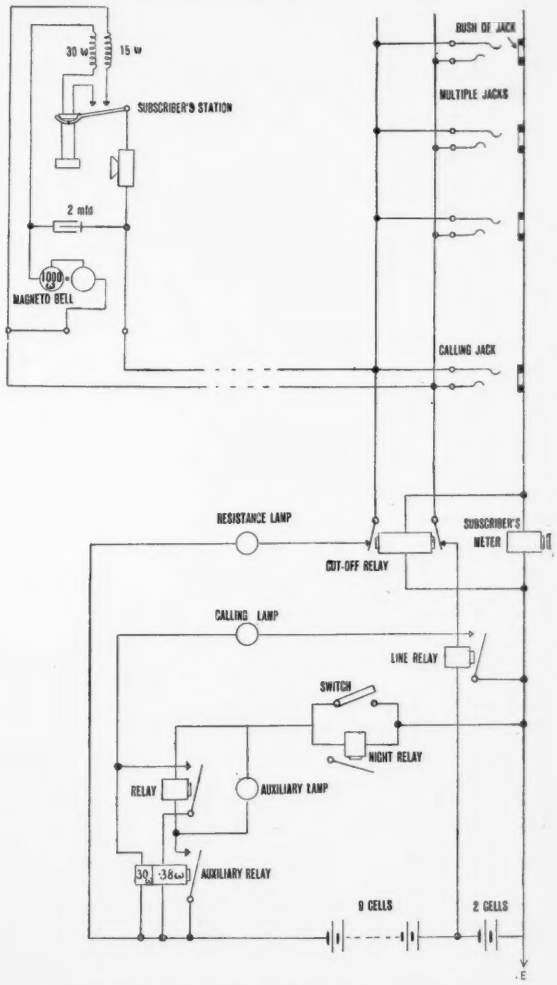


Diagram of Connections Between Subscribers' Station and Exchange.

it to light up, so as to attract the attention of the operator. A lamp of 60 ω resistance is inserted in series with the other line; its functions will be dealt with later.

The indicator lamp is directly under the jack allotted to the subscriber who is calling. Hence, the operator has no need to recognise a number as in the older methods, and to find the corresponding jack some inches or feet away; in fact, she does not require even to *know* the number of the calling subscriber.

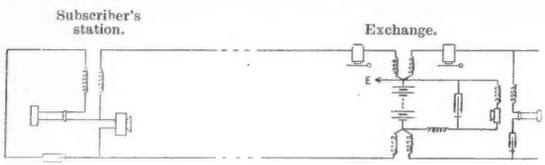
Inserting an answering plug into the jack indicated (whereupon the calling lamp goes out), and pressing forward a switch on the keyboard, the operator is at once in communication with the subscriber, ascertains the number wanted, and proceeds to make the desired connection.

For this purpose she takes up the calling plug corresponding with the answering plug just used, and taps the brass bush of the wanted subscriber's jack, with the tip of the plug. If she hears a click in her receiver, she knows that the subscriber's line is engaged, and informs the calling subscriber of the fact. If silence reigns, however, she pushes home the plug, and pulls over the switch previously used to speak to the caller. The first operation causes a lamp to glow, and the second rings the bell of the subscriber wanted. Directly he lifts his receiver his "clearing lamp" goes out, acquainting the operator with the fact that the subscribers are connected. She then presses a button, which registers one call on her own meter and on that of the caller. When the two sub-

scribers have finished their conversation, and hung up their receivers, both their clearing lamps light up; the operator sees this and removes the plugs, when all is ready for a new call. If, however, one of the speakers wishes to leave the telephone for a moment without breaking the connection, and hangs up his receiver, his own clearing lamp goes out, but the other remains alight; under these conditions the operator knows exactly what is going on, and does not cut off the connection so long as one or other of the lamps remains unlighted.

Returning now to the diagram of the subscriber's circuits, we shall trace out the connections and see what happens.

As noted already, when the subscriber lifts up his receiver, an indicator lamp lights up on one of the panels at the exchange, through the operation of the line relay. Referring to the diagram, it will be seen that the current through this lamp also traverses the 30ω coil of an auxiliary relay. This



Subscriber Speaking to Operator.

attracts an armature and closes another circuit from the + (earthed) end of the battery, through a ·9ω relay (which rings a bell at night, but is short-circuited by a switch during the daytime), and through an auxiliary lamp, to the — pole of the battery. The auxiliary lamp is shunted by a 250 relay, which acts, and shunts the 30ω coil of the auxiliary relay with a ·38 ω coil on the same core; while the 30 ω coil is necessary to pull up the armature of the auxiliary relay, the ·38ω coil is easily able to securely hold it. Were it not for this device, if more than one subscriber were to call simultaneously, the resistance of the 30 ω coil would cause too great a drop of pressure with the large current, and the lamps would burn dimly. Be it noted that, so long as a single call remains unanswered, the auxiliary lamp continues to glow (and, at night, the bell keeps on ringing).

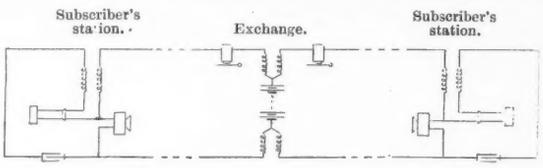
It remains for us to explain why a 4-volt section of the battery is divided off at the + (earthed) end.

The 30 ω relay in circuit with the bushes of the jacks has not so far been mentioned, as it is operated by the keyboard circuits. Its effect is to cut off the whole of the subscriber's indicating and auxiliary circuit directly the operator inserts a plug in the calling jack. For this reason it is called the cut-off relay. It will be obvious that when this acts, not only will the subscriber's indicator lamp go out, but the auxiliary lamp will also be extinguished, *unless some other* subscriber is calling.

We pass on now to the operator's keyboard circuits.

The diagram below shows the complete connections for one pair of cords, though, of course, some of the apparatus, such as the battery, generator, meter, and speaking set, is common to all the cords at one position.

There is a repeating coil in each cord circuit. This consists of a small transformer with four windings, each of



Subscribers Speaking Through Central Exchange.

40 ω resistance, the battery being connected as shown in the diagram. These coils practically form the dividing points between the calling and answering subscribers' circuits. As already mentioned, the repeating coils are placed in a rack in the basement, so as to minimise the resistance between them and the battery. It will be readily understood that, as the battery is common to all the subscribers, if any fluctuation in its terminal P.D. were caused by the currents used by any two subscribers, the same fluctuations would be imposed upon every other subscriber's circuit, so that considerable annoyance would result. The battery must, therefore, have an exceedingly low internal resistance, and the common battery leads, as far as the point of distribution, must be as short as possible and very thick.

Tracing out the circuits, it will be seen that normally the tips of the plugs are connected *via* the repeating coil and one of the springs of the ringing key; the rings of the

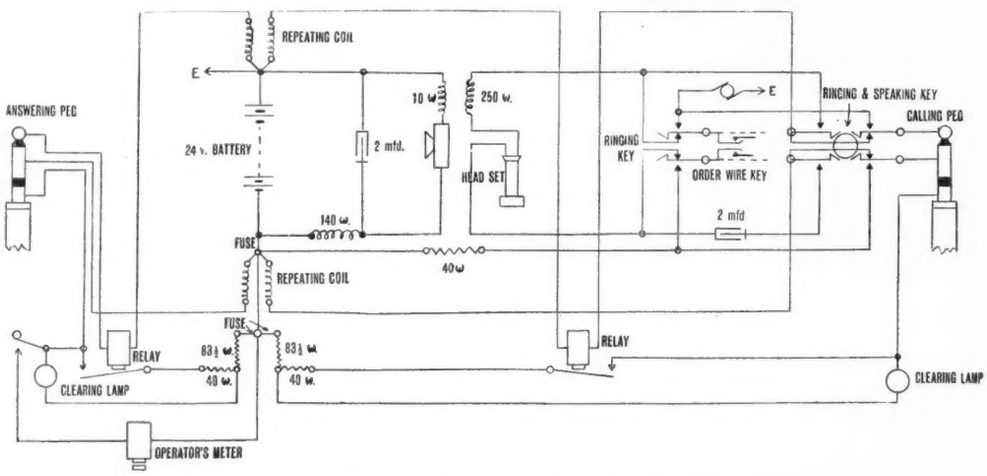


Diagram of Connections of Cord Circuits on Operator's Keyboard.

Should an earth occur on the — line, it will be seen that the circuit from the earth connection of the battery is completed through the fault, through the 60 ω resistance lamp, to the — pole. This lamp therefore lights up, and thus calls attention to the fault.

Next, suppose the + line goes to earth. The 4-volt section now operates, sending a current through the fault, through the 60ω relay, to the tee between the second and third cells. Consequently the line relay closes the circuit of the line indicator lamp, which glows as well as the auxiliary lamp, and shows the fault. The operator recognises this directly she attempts to answer the apparent call. A short circuit on the line also lights up the calling lamp.

plugs are connected by a similar circuit. The base of each plug is connected with the battery through a 12-volt lamp, having a resistance of 120 ω, and through a resistance of $83\frac{1}{2}$ ω; this raises the potential of the bushes of the two subscribers' multiple jacks above earth potential when they are "through," so as to give the engaged signal when some other operator tests the jacks with the tip of a plug. In the tip circuit, in each case, there is a 10ω relay, which is normally open. When the answering plug is inserted into the calling subscriber's jack, the current which flows actuates this relay, and places a 40 ω shunt across the lamp, which therefore ceases to glow. Similarly, when the second subscriber takes his receiver off the hook, the second lamp is

extinguished; but whenever either of these subscribers hangs up his receiver, the corresponding relay opens and the lamp lights up. When both lamps are alight the operator recognises that the conversation is over, and clears the connection.

The connections of the operator's "head set" are shown in the middle of the diagram. This is brought into operation by means of the "speaking and ringing" key shown on the right hand. Inserting an answering plug into the calling subscriber's jack in the local section, and pressing the key from her, the operator asks the number required; she then tests the corresponding jack on the multiple board with the calling plug, and if the line is clear, inserts the plug and pulls the key towards her. This, it will be seen, disconnects her head set, as well as the calling subscriber's line, and joins the ringing generator to the wanted subscriber's line. As soon as the latter removes his receiver from the hook, his clearing lamp goes out, the operator releases the ringing key (thereby also connecting the two subscribers through the inner contacts of the key) and the operation is complete; but it has to be recorded, and for this purpose the operator presses the meter key shown on the left hand. This allows a current to flow through the operator's 20 ω meter to the bush of the calling subscriber's jack; a reference to the previous diagram shows that this current also flows through the cut-off relay and the subscriber's meter on its way to earth. The subscriber's meter has a resistance of 600 ω, and is not affected by the current flowing through it, in parallel with the cut-off relay, *viâ* the large resistances previously in circuit; but when the large current flows through the operator's low resistance meter, sufficient passes through the subscriber's meter to actuate it, while, of course, the cut-off relay is merely held the tighter.

The microphone in the operator's head-set is shunted by a condenser of 2 microfarads, and has in series with it a "retardation," or impedance, coil of 140 ω resistance, in addition to the primary of the induction coil, which is wound to 10 ω resistance. The receiver is in series with the secondary coil, of 250 ω resistance, and in addition to speaking on subscribers' lines—in which case it is in series with a 2-microfarad condenser—can be used for communicating with other exchanges. For this purpose the "order wire keys" are provided. Pressing the key corresponding to the exchange required, the operator speaks at once on the call wire to an operator in the other exchange, who is always listening in the busy hours of the day; at night time, before speaking, it is necessary also to press the ringing key shown in the diagram. The answering operator gives the number of one of the junction wires, for which jacks are provided at each position, as already mentioned. The first operator then inserts the calling plug into the proper jack, and this brings us to the junction board.

(*To be continued.*)

ELECTRIC TRACTION NOTES.

(*Continued from page* 1044.)

Burnley.—On 11th inst. Major Druitt and Mr. Trotter, of the Board of Trade, inspected the new electrical tramways that have been laid between Padiham and Nelson through Burnley and Brierfield, and covering a distance of about 8 miles. The overhead equipment is so far completed as to enable cars to run nearly 3 miles from Burnley in the direction of Padiham. This portion of the line was examined, and later in the day the Corporation commenced a public service of cars along this portion of the line. The approximate cost of the entire undertaking is about £150,000.

Cleethorpes.—The Electricity Committee recommends that a sum of £32,500 be provided for in the Council's Improvement Bill for the purchase of the generating station and plant from the Great Grimsby Tramways Company, and for the supply of electrical energy for lighting and traction purposes.

France.—Several French capitalists are at present studying the project of an electric tramway from Dijon to Chagny, which will traverse the rich vineyards of the country. The project stipulates for electric traction and comprises the electric lighting of the intervening communes and "chateaux," as well as the supply to these latter of electric energy.

Lancaster.—The T.C. on Wednesday accepted tenders (£20,000) for electric tramways construction. (See under "Contracts Closed."

L. & N.W. Railway.—The newspaper press announces that it is practically decided that the working of the London and North-Western Railway by electric power is to be first tried on some of their branch lines. It seems that the proposal is to use electric motors instead of steam locomotives for the trains which run between Broad Street and the Mansion House *viâ* Willesden.

Light Railways.—The *Times* says that the Board of Trade have recently confirmed the following Light Railway Orders:—Halesowen Light Railway Order, 1901, authorising the construction of light railways in the rural district of Halesowen in the county of Worcester; Amesbury and Military Camp Light Railway (Amendment) Order (1901), amending the Amesbury and Military Camp Light Railway Order, 1898; Bardfield and Sible Hedingham Light Railway Order, 1901, authorising the construction of a light railway in the county of Essex, to join the proposed Elsenham, Thaxted, and Bardfield Light Railway with the Colne Valley and Halstead Railway; Bridgwater, Stowey, and Stogursey Light Railway Order, 1891, authorising the construction of a light railway in the county of Somerset, from Bridgwater to Nether Stowey and Stogursey.

Liverpool and Manchester.—It is announced that on the 17th inst., plans for the proposed electric railway between Liverpool and Manchester were deposited with the Board of Trade.

Liverpool.—At a special meeting of the City Council last week consideration was given to a new Bill which is to be promoted in Parliament. A proposal was made by Alderman Bartlett that a clause be confirmed giving the Council power to charge the cost of street improvements for the tramways service against tramways capital or revenue account. Mr. Higginbottom asked for the clause to be withdrawn. The Tramways Committee, he said, had no objection to what the Council might do with the profits, but the Committee wanted to be allowed to carry on the business so as to secure profits. They had only a very small reserve. This year they had given £35,000 to £40,000 more in extra wages to their servants. Why should there be a possibility of the Committee being asked to pay a million of money for widening streets? The tramway service was making very solid progress. It was a great and sound concern, and if the Committee were allowed to carry on their business as they had been doing they hoped in a year or two to present a surplus to the Council, and say, "Dispose of it as you like." It was dangerous at present to interfere with the tramways undertaking. On a division the proposal was carried by 57 votes to 27, but as the majority was less than that required by statute, the clause could not be included in the Bill.

At the Liverpool Assizes last week, a widow, named Catherine Stewart, was awarded £125 as damages against the Corporation for injuries received by an electric car accident on January 12th last.

Lowestoft.—The Tramways Committee's proposal that the borough surveyor should act as engineer to the tramways, and, in addition to his salary, be paid the sum of £140 per mile single line upon the tramway track and the sum of £87 upon the construction of the car sheds, was referred back for reconsideration by the Council at last week's meeting. One member said he had a growing distrust of experts; the work was not of a kind which required technical knowledge.

Mitcham.—The Parish Council has considered the various proposals of the Croydon and District Tramway Company, the L.U.T. Co., and the London and Brighton Electric Railway Company, and has decided to give notice of dissent against all three. The tramway companies, however, are informed that opposition will be withdrawn if sundry concessions are made as to street widenings.

Newcastle.—Last week Board of Trade officials inspected the new system of electric tramways installed by the Corporation.

The Mayoress set the first car in motion on Monday. There are 20 miles of double track, extending to all of the suburbs. Mr. A E. Le Rossignol is the Corporation tramways manager.

Perth.—The T.C. have now finally agreed to acquire the tramways, at present in the hands of a private company, by arbitration.

Port Glasgow.—The application by the Corporation to interdict Greenock from supplying, without consent, electric power to the tramways within the former burgh, was before Sheriff Glegg recently. Defenders stated that there was no reason to ask consent, the power being supplied in bulk, and the mains and other apparatus belonging to the tramways company. The Sheriff postponed the case on the application of the defenders in order that the tramway company should be called as a party.

Richmond and Hampton Court.—The construction of the L.U.T. branch line to Hampton Court will be commenced at Richmond Bridge, and the company's surveyors have completed their work through Twickenham and Hampton Wick, at which latter place it is intended to have a car depôt. The chairman of the Richmond Main Sewage Board has been empowered to take steps to safeguard local interests in the matter of the proposed line along Lower Mortlake Road, sundry difficulties having arisen as to the removal of manholes.

Sutton.—The *Sutton Herald* continues an active crusade against the local tramway proposals, and publishes a long list of points at which it is alleged it would be very dangerous to run electric trams on account of the narrowness of the roads.

Sheffield.—The management of the Sheffield Corporation Tramways are giving a trial to a new kind of lifeguard or cow-catcher, the existing guard having proved unsatisfactory. A band of steel, about 1 in. from the ground, and some 6 or 8 in. high, has been placed entirely round the underneath part of one of the cars. The band is bolted on to the framework of the truck, and encloses the wheels. Experiments made with dummy figures go to prove that the arrangement will be entirely successful in pushing people, who may get in front of the car, out of the way.

Sunbury.—The U.D.C. Highway Committee considered plans deposited by the L.U.C. for light railways to be constructed through the district, and on their recommendation the Council decided to object because the proposed Order does not make provision for surface water drainage where interfered with by the company's works; and the scheme does not include an extension to Lower Sunbury. The Council also wants other clauses relating to up-keep of roads, construction of footpaths, &c., inserted.

The "Underground" Railways.—Laffan's New York correspondent telegraphed on 12th inst. as follows:—"Mr. Yerkes has awarded the contract for the electrification of the Metropolitan District Railway to the Westinghouse Electric and Manufacturing Company, of Pittsburg. The work, or the greater part of it, will be undertaken at the company's works at Manchester, and it is hoped that a start may be made within the next few weeks. A portion of the installation will be put in hand at once, at the company's works at East Pittsburg, Pennsylvania, in order to hasten the construction of the plant. The electrical generators will be larger than those of the Manhattan Elevated Railway of New York, which, up to the present, are the largest in the world. The Westinghouse Company's generators at Niagara Falls are of 5,000 H.P. each. Those of the Manhattan Elevated Railway are of 6,500 H.P., while those manufactured for the Metropolitan Railway will be of over 7,000 H.P. They will be driven by turbine engines. The generating machines of the Manhattan Elevated Railway weigh 370,000 lbs. apiece, and are each 42 ft. high. The Metropolitan electric generating station will have a minimum capacity of 70,000 H.P., and a maximum of 100,000. The work will be begun immediately, and within two years from January 1st, 1902, the old smoky tunnels will be whitened, ventilated, and served with an up-to-date service of electric trains."

Underground Railways.—The *Birmingham Post* says that Messrs. Milward & Co., Waterloo Street, Birmingham, have received instructions from gentlemen in London representing a syndicate interested in the promotion of underground tubular railways to take action in view of an application to Parliament for powers to construct a complete system of underground tubes for Birmingham.

Walsall.—The T.C. on Monday resolved to enter into contracts for the purchase, at an estimated cost of £15,500, of 9,000 tons of granite setts required for the carrying out of the tramway extensions authorised by the Council.

The Tramways Committee reported that they had entered into negotiations and arranged with the South Staffordshire Tramways Lessee Company, Limited, for them to work the proposed extension to Bell Lane, Bloxwich, for the remainder of the three years' term at a fixed annual rent of £400, subject to the company undertaking to take from the Corporation a supply of current for working the whole of the Bloxwich section on terms to be agreed upon. The Council are about to apply to the L.G.B. for their approval of the Corporation appropriating certain land for the purposes of a transformer station to be used for supplying the tramways with current.

West Bromwich.—At the annual meeting of the T.C. not long ago, according to a local paper, it was stated that the main cables were to be laid "in tar and sand." Whether this was the fact, or a printer's error, we do not know; but if the former, we must conclude that the West Bromwich Council is doing its work on the latest and most municipal lines. Why not tar and feathers?

Wolverhampton.—Our correspondent says that the Tramways Committee had been promised by the Lorain Company a trial trip of the new electric tram on the Bilston Road for Thursday, December 12th. At the meeting of the Committee on Tuesday in last week the trial was postponed for "a week or so." There was, however, a test on Saturday evening of one of the cars which was put on the metals for the first time. The test took place in the new depôt in Cleveland Road. The car was run up and down the line laid in the building several times, and all the appliances were well tested. Brilliantly lighted and almost sumptuously fitted up, the car—a single-decker—presented a striking appearance.

Yarmouth.—The Town Council have had under consideration the tenders for leasing the new tramways now being constructed. The British Electric Traction Company's tender is for a lease of 21 years, with an option to the Corporation to terminate at 14 years on terms; the company to pay £75 per route mile for road maintenance and repairs, and an annual rental equivalent to interest and sinking fund on capital outlay, with a further 5 per cent. on the gross receipts from May to September in any one year; the company to provide rolling stock, but would require the Corporation to take this over at valuation. The company offered 2d. per unit for current for the first 200,000 units, and 1½d. for all beyond. The company offered a contribution of £1,500 towards the widening of Southtown Bridge in order that the Yarmouth and Gorleston systems might be linked together. A further offer is made of 2 per cent. on the cost of street improvements. The company having purchased the Yarmouth and Gorleston tramways offered to sell them at the par value of the shares and debentures, and to obtain the necessary powers for connecting the two systems. The terms were not considered adequate, and the Town Council have decided not to accept the tender. The only other tender received was from Messrs. Montagu, Hibbards & Co, 14, St. Clement's Lane, London, offering the following terms: 21 years' lease; payment of proportional interest and sinking fund during lease on capital outlay; payment of 5 per cent. on gross receipts, or 10 per cent. net profits for first year, increasing 1 per cent. per annum until end of lease; 2½d. for current. The Council decided to obtain further particulars from the firm.

TELEGRAPH AND TELEPHONE NOTES.

Australian Cable Rates.—A Reuter dispatch from Melbourne says that the Federal Cabinet has authorised Mr. Blake, the Postmaster-General, to negotiate with the Eastern Telegraph Company with a view to bringing all the States under uniform cable rates.

Burnley and Nelson Telephones.—The authorities of the Burnley and Nelson telephone area have been in communication with Messrs. Bennett & Ward-Thomas regarding the question of municipalising telephones in their area, and it is understood that all the authorities are unanimous in their decision to apply to the Postmaster-General for a license.

Congo Telegraphs.—Mr. Mohunt, who has just returned to Europe from the Congo, where he was commissioned to establish a line of telegraph between Lake Tanyanika and the Congo, has terminated upwards of 460 kilometres with considerable difficulty. Iron telegraph poles were utilised, as the white ants attack those in wood. In addition to this line, a connection between Boma and the equator, as well as different other minor schemes, are in project. But before executing them the Congo Free State is desirous of testing the possibility of utilising wireless telegraphy. Experiments with this view will be carried out at an early date.

Hull Telephones.—At a meeting of the Corporation Telephones Committee last week, the town clerk read a letter from the Postmaster-General enclosing a copy of a letter from the National Telephone Company (for observations). The letter stated that the company had expended £50,000 in reconstructing their system in Hull underground, under an agreement with the usual clause, enabling the Corporation to put an end to it by giving six months' notice. The Corporation had given notice terminating the agreement, and this notice had expired, but they had not acted upon it, except to allege that the company was now a trespasser. If the Postmaster-General granted a license to Hull, the Corporation, when they had provided a duplicate plant, would be in a position to require the company to take up their underground plant, or, in other words, to confiscate the large capital which the company had invested in Hull upon the faith of the agreement, and under these circumstances the only course left to the company was to bring the service to a stop, and to proceed to take up the pipes, in the hope that this drastic measure would compel the Corporation to withdraw their notice, and accept the terms which Parliament had thought reasonable and fair. The letter, concluding, asked the Postmaster-General to afford the representatives of the company the opportunity of a personal conference before granting the licence. The town clerk, in his reply, after referring at some length to the agreement, said the Corporation felt they were fully justified in taking steps which would prevent the notice clause being rendered inoperative. The Corporation attached no importance to the threat to bring the service to a stop. A similar threat was made in 1899. The reply adds: "It is respectively submitted that the Postmaster-General has no power to require, as a condition of granting a license, that the notice terminating the agreement should be withdrawn, and that in any event to do so would be unjust to the Corporation."

Surrey and Middlesex.—Nearly all the local authorities in suburban Surrey and Middlesex are sending representatives to the London conference to protest against the new telephone arrangements. The Richmond T.C. has declined also to allow the N.U.T. to place lines underground, the streets having only recently been reinstated after the laying of the post office wires.

Sunderland Telephones.—The T.C. last week discussed the question of applying for a telephone licence, and the matter was adjourned to next meeting.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Para-Maranham	March 1, 1900	
Marseilles-Barcelona	Dec. 4, 1901	Dec. 17.
New Brunswick-Prince Edward Island	Dec. 10, 1901	
Trinidad-Demerara	Dec. 12, 1901	
Anjer-Kalianda	Dec. 17, 1901	
Landlines:—		
"*Via* Hanekin" on Persian territory	Feb. 24, 1900	
Communication with Baranquilla and Cartagena towns of Venezuela	Dec. 8, 1900	
"	Oct. 31, 1900	
Majunga-Tanarive	Dec. 15, 1991	

The Telephone Question.—At a meeting of the City Corporation last Thursday it was resolved on a motion by Mr. Morton that a letter be written to the Chancellor of the Exchequer and the Postmaster-General, requesting that they would not ratify any agreement with the National Telephone Company with regard to the charges for the telephone service until the Corporation had had an opportunity of considering the proposed agreement or agreements; that such agreements may be fully considered by Parliament; and also that application be made to the Postmaster-General for a copy of the proposed agreement or agreements.

Tunbridge Wells.—At a special meeting of the Corporation, on Tuesday, the Telephone Committee recommended the raising of a further £15,000 for the purpose of extending the system. The original scheme, costing £10,000, provided for 329 subscribers, but in less than 12 months the Corporation has secured nearly 600 customers, and more are being added every week. The majority of these have the unlimited service at £5 17s. 6d. per annum, which is the maximum charge.

Wireless Telegraphy.—With reference to Marconi's latest reported achievement, it is necessary to note the following message sent by him to the *Times* from St. Johns, Newfoundland, as follows:—"In consequence of the threatened legal proceedings against myself by the Anglo-American Telegraph Company, which claims the monopoly of telegraphic communications in Newfoundland, I am compelled to discontinue wireless telegraph tests between England and this Colony. I hope to continue shortly with similar experiments between England and Canada or the United States."

The *Times* New York correspondent says that only two years of the monopoly are unexpired, and the public thinks the company should not prevent the colony from enjoying the benefits of the new invention. The New York officials of the company decline to discuss the matter, and say that their instructions regarding the injunction came from the other side.

A later dispatch says that the Anglo-American Company is receding from its original attitude and an arrangement may be effected with Mr. Marconi.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking Town.—January 24th. Additional generating plant for the Council's electricity works. See "Official Notices" to-day.

Barnstaple.—January 16th. Boilers, engines, dynamos, mains, &c., for the Town Council. See "Official Notices" December 13th.

Barrow-in-Furness.—Wiring the new Town Hall for the Corporation. C. F. Preston, town clerk.

Belgium.—March 1st. The municipal authorities of Ghent are inviting tenders until the March 1st, 1902, for the concession for an electric lighting installation. Tenders are to be sent by registered letter to La Collège, Echevinàl, Ghent, while full particulars can be obtained from Le Bureau des Travaux.

Birkenhead.—The Corporation Tramways Committee invite tenders for a supply of the following stores for the 12 months ending December 31st, 1902:—Poplar wood blocks; cast-iron brake blocks and other castings; motor grease; river sand; cleaning cloths; sponge cloths and brushes.

Bournemouth.—January 6th. Feeder cables, pilot and arc lighting cables, and conduits, for the Corporation tramways. See "Official Notices" to-day.

Chili.—The Chilian Government proposes to establish a cable connecting Punta Arenas and Puerto Mount. Estimates will be received at the Chilian Legation, London, where particulars of the undertaking can be obtained.

Egypt.—January 18th. Electric lighting of Suez and Damanhour. Particulars from the Minister of Public Works, Cairo.

France.—December 27th. Tenders are being invited by the French Post and Telegraph authorities in Paris until the 27th inst. for the supply of 30 tons of iron wire 8 mm. diameter and 85 kilometres of submarine cable core. Particulars can be obtained from and tenders are to be set to Le Sous-Secretariat d'Etat des Postes et de Telegraphes, Rue de Grenelle, 103, Paris.

Hornsey.—January 15th. Pipework and mechanical coal-handling plant for electricity works for the U.D.C. See "Official Notices" December 6th.

Kirkcaldy.—January 8th. Piping, pumps, feed heater, &c., for electricity works. See "Official Notices" December 13th.

Manchester.—January 21st. Three-phase switchboards, exciter and auxiliary ditto, three-phase boards for sub-stations, low tension boards at sub-stations at the Stuart Street generating station. See "Official Notices" to-day.

Middlesbrough.—January 21st. 300-KW. engine and dynamo, switchboard panels, ejector condenser, feed pump and economiser for the electricity works. See "Official Notices" to-day.

Nantwich.—January 6th. Water-tube and Lancashire boilers, steam dynamos, pumps and piping, switchboard, mains, posts, battery, meters, crane and dust destructor for the U.D.C. See "Official Notices" November 22nd.

Reading.—December 28th. Water-tube boilers, economiser, pumps, engines, condensing plant, generators, switchboard, crane, motors and car equipments, car bodies, trolleys, &c., for the Corporation. Borough engineer's office, Town Hall. Specifications &c. 10 guineas.

Roumania.—December 30th. Tenders to the Roumanian Post and Telegraph authorities in Bucharest, for the supply of 5 tons of bronze wire 1½ mm. diameter. Tenders are to be sent to La Direction des Postes et des Telegraphes, Bucharest, whence particulars may be obtained.

Sunderland.—December 20th. Cast-iron pipes and copper piping, valves, &c., for electric light station. See "Official Notices" December 6th.

Wakefield.—December 21st. Cables and street transformers for the Corporation. See "Official Notices" December 13th.

Warrington.—December 31st. Electric light mains and fittings at the tramways car depôt for the Tramways Committee. See "Official Notices" December 13th.

Warrington.—January 4th. Tramway shop equipment and switchboard extensions for the Corporation. See "Official Notices" to-day.

West Bromwich.—January 17th. Rails, points, crossings, drain rails, road work, bonding, trolley poles, overhead line work, section boxes, cables, &c., for electric tramways for the Council. See "Official Notices" to-day.

West Ham.—January 14th. Surface condensing plant and travelling crane for the electricity works. See "Official Notices" December 13th.

Wolverhampton.—December 20th. Two-phase motor-generators, boosters, switchboards, and battery, for Midland Electric Corporation. See "Official Notices" December 6th.

CLOSED.

Ayr.—The T.C. has accepted the following tenders in connection with the extension of the tramways to Burns's Monument:—Permanent way, D. Murray, Glasgow, £7,611; rails, Lorain Steel Company, U.S.A., £2,577; overhead equipment, Lowdon Bros. and Co., Dundee, £1,820; cable, Callender's Company, London, £1,292. Five additional cars, costing about £3,000, will be supplied by Hurst, Nelson & Co., Motherwell. The extension of the line is about 1¾ miles in length.

Birkdale and Southport Light Railways.—The generating plant for this, comprising three 150-B.H.P. direct-coupled sets, has been ordered from Messrs. D. Bruce Peebles & Co., with engines by Messrs. Browett, Lindley & Co.

Bradford.—The Corporation have ordered additional motors for hiring as follows:—Messrs. D. Bruce Peebles & Co., Edinburgh, one 40-H.P., £213; Messrs. Veritys, Limited, Manchester, one 15-H.P., £105, and two 7-H.P., £75 each; Messrs. Rosling and Fynn, Limited, Bradford, three 10-H.P., £87 each.

Bristol.—The Docks Committee has accepted the tender of Messrs. Holmes & Co., for electric motors for the movable grain elevator at Avonmouth.

France.—The French Post and Telegraph authorities in Paris have just placed some large contracts for the supply of high conductivity copper wire. La Compagnie des Trefileries de Havre will supply 50 tons 2½ mm. diameter at 208½ fr. per ton; 50 tons ditto at 209 fr. per ton; 50 tons, ditto, at 209½ fr., and 50 tons 3 mm. diameter at 208 fr. per ton. La Compagnie Générale d'Electricité, of Paris, will supply 100 tons, ditto, 2½ mm. diameter at 207 fr. 40 c. per ton, and 50 tons, 3 mm diameter at 207 fr. 40 c. per ton. La Compagnie Française des Métaux, of Paris, will supply 50 tons, ditto, 2½ mm., at 211 fr. 90 c. per ton; 50 tons, 4 mm. diameter, at 208 fr. 90 c., and 50 tons, ditto, at 209 fr. 40 c. La Société d'Electro-Metallurgique de Dives, 50 tons, 3 mm diameter, at 215½ fr. per ton. La Compagnie Française du Bimetal, of Paris, 50 tons, 3 mm. diameter, at 213 fr. 40 c. per ton, and 50 tons, ditto, at 209 fr. 40 c.

Hammersmith.—The Borough Council on Wednesday accepted tenders as under:—

British Westinghouse Electric Company, 175 5-ampere meters, £577 10s. Messrs. Chamberlain & Hookham, 80 10-ampere meters; 40 15-ampere meters; 50 25-ampere meters; 20 50 ampere meters; five 75-ampere meters; five 100-ampere meters—total, £740.

Huddersfield.—The Corporation, on Wednesday, accepted the tender of Messrs. Ferranti, Limited, for the supply and fixing of a 600-KW. plant in the electric lighting department at £5,220. It was also resolved to invite tenders for materials required in connection with the permanent way, bonding, &c., for the tramway extensions.

Huddersfield.—On Wednesday the Corporation accepted the following tenders for the conversion of lines to electric traction, and for plant at the power station. Over 100 tenders were received, and several of them were sent by foreign firms:—

	£	s.	d.
Traction generator, Mather & Platt, Limited	2,050	0	0
Lancashire boiler and fittings, J. Horsfield & Co., Dewsbury	787	0	0
Boiler and pipes, Babcock & Wilcox	290	0	0
Mechanical stoker and conveyer, T. & T. Vicars, Limited	195	0	0
Economiser, E. Green & Sons	124	0	0
Switchboard, Bertram Thomas	1,465	0	0
Car bodies, trucks and electric car equipment, British Electric Car Company	12,737	10	0
Boosters, T. W. Broadbent, Huddersfield	1,440	0	0
Engine, Messrs. Fairburn, Lows, Coombe & Barbour, Ltd.	3,720	0	0
Cables and conduits, Bertram Thomas	10,509	0	0
Total	£47,987	2	0

The new equipment will embrace about half the Huddersfield system, that is, about 14 or 15 miles.

Hull.—The Corporation has accepted the tender of Messrs. Parker & Co., Wolverhampton, for six additional transformers at £4,230, and for switchgear at £762.

Kirkcaldy.—The Town Council has accepted the following tenders for the tramways undertaking:—British Insulated Wire Company, Limited, Prescot, overhead construction, £3,487; Improved Glow Lamp Company, arc lamp-posts, £453; and Cox-Walkers, Darlington, for the switchboard and motor-generators, £2,746.

Lancaster.—The Tramways Committee on Wednesday considered the report of the tramways engineer on the various tenders sent in for materials and works for the tramways. The Corporation has now accepted the following tenders:—

	£	s.	d.
Section A.—Rails, fishplates, sole-plates, tie-bars, bolts, bonds, points and crossings, &c., Messrs. Walter Scott, Limited, of the Leeds Steel Works, Leeds	4,876	1	3
Section C.—Overhead trolley equipment, Messrs. Lowdon Bros. & Co.	2,569	5	0
Section D.—Cables, pilot wires, cases, &c., Messrs. Callender's Cable and Construction Company, Limited	721	16	9
Section E.—Tramcars, British Westinghouse Company	3,693	15	0

London.—The London County Council on Tuesday accepted the undernoted tenders for wiring and fittings for the three Fire Brigade stations mentioned:—(1) Manchester Square station, Ellis, Potten & Co. (accepted), £170; (2) Bishopsgate station, Ellis, Potten & Co. (accepted), £153; (3) Brompton station, Jackson Brothers (accepted), £98 2s. 6d.

Metropolitan Electric Supply Company, Limited.—This company has accepted the following tender: For one 200-kw. continuous to alternating current motor-generator, Messrs. Veritys, Limited, King Street, W.C.

Perth.—Messrs. Crompton & Co., Limited are to supply the Council with arc lamps for street lighting at £5 6s. each.

Reading.—The Tramways Committee recently received a letter from Mr. E. Nuttall, of Manchester, confirming his tender for contract No. 1, subject to certain conditions for ensuring that Sykes conduits and English steel rails only shall be supplied by him, and submitting for approval the names of Messrs. Bolckow, Vaughan & Co., of Middlesbrough, as the manufacturers of the rails. The Committee resolved that the firm of Messrs. Bolckow, Vaughan & Co., of Middlesbrough, be approved as the manufacturer of the rails to be used in the construction of the tramways.

Rochdale.—The contract for generators for the above Corporation has been placed with Messrs. Bruce Peebles & Co. at £850.

South Africa.—The Corporation of Capetown has placed a large order for engines and electrical plant in this country. The order for engines has been placed with Messrs. Ferranti, Limited, of Hollinwood, Lancs., and the dynamo machinery with Messrs. Dick, Kerr & Co., of Preston, the size of each unit being 1,200 H.P. The recent success of these firms in the London County Council tramways contracts will be remembered.

Willesden.—The following is a list of the tenders accepted for the plant required to equip the Willesden U.D.C.'s electricity works. Seventy-nine firms tendered and sent in, including alternatives, over 320 tenders. Mr. E. T. Ruthven Murray is electrical engineer to the Council:—

	£	s.	d.
Section A.—Boiler house plant, Messrs. Babcock & Wilcox, Limited	5,502	0	0
Sections B and D.—Steam dynamos, rotary converters and balancers, the British Westinghouse Electric Co.	10,363	0	0
Section C.—Transformers, the British Electric Transformer Company	900	0	0
Section E.—Switchgear (high and low pressures), Messrs. Ferranti, Limited	4,527	0	0
Section F.—Overhead travelling cranes, the Chatteris Engineering Company (8-ton hand traveller)	148	10	0
Messrs. Broadbent & Sons, Limited (12-ton electric traveller)	545	0	0
Section G.—Accumulators, the Tudor Accumulator Company (two batteries)	3,302	0	0
Section H—Mains (high and low pressure), the British Insulated Wire Company, Limited	22,917	0	0
Section I.—Public lamps, not yet adjudicated	—		
Section J.—Steam pipes, Messrs. Babcock and Wilcox, Limited	425	0	0
Section K.—Condenser and cooling plant, Messrs. Ashton, Frost & Co., Limited	1,011	0	0
Messrs. Körting Bros.	516	0	0

Southport.—A resolution of the Tramways Committee that the tender of Messrs. Dick, Kerr & Co., Limited, to supply four additional double-deck tramcars at £575 each, be accepted, was passed by the T.C. last week.

FORTHCOMING EVENTS.

Friday, December 20th.—At 8 p.m. Institution of Civil Engineers. Students' meeting. Paper on "Transmission Dynamometers," by A. M. Morgan.

Saturday, December 28th.—At 3 p.m. Royal Institution. Lecture I., on "Waves and Ripples in Water, Air and Æther," by Prof. J. A. Fleming, F.R.S.

NOTES.

Our Next Issue appears on Tuesday morning, instead of Friday. We repeat our notice of last week to the effect that editorial matter must be here by Saturday, December 21st.

The Underground Railways.—The following is a copy of the decision of the Board of Trade to which we briefly referred last week:—

At the Board of Trade.

Whereas pursuant to Sec. 9 of the Metropolitan District Railway Act 1901 the Board of Trade did by writing dated the 18th day of September 1901 appoint the Special Tribunal referred to in the said section to hear evidence and to report to the Board of Trade as to the system of Electrical working which should be applied on the portions of the Railways of the Metropolitan District Railway Company and the Metropolitan Railway Company forming part of the Inner Circle Railway and also on the City Lines and Extensions Railways of the two Companies.

And whereas the said Tribunal so appointed has duly made its report to the Board of Trade and the Board of Trade have considered the same.

Now therefore the Board of Trade in further pursuance of Sec. 9 of the said Act do hereby determine that the system of electrical working which shall be applied on the portions of each of the said Companies Railways forming part of the Inner Circle Railway and also on the City Lines and Extensions Railways of the said two Companies shall be the system described in a statement dated the 5th September 1901 signed by the Secretary of the Metropolitan District Railway Company and declared and submitted by the said Metropolitan District Railway Company as the system of electrical working which it desired to adopt and which system may be shortly described or referred to as the "continuous" current system of electrical traction.

Dated this 11th day of December 1901.

(Signed) Francis J. S. Hopwood, Secretary.
Board of Trade.

L.C.C.—At last week's meeting the Parliamentary Committee reported having prepared the London County Council (Subways and Tramways) Bill, which proposed to authorise the Council to construct a subway from Victoria Embankment to Southampton Row and to work an electric tramway therein, accommodation being provided for pipes and wires. It was also proposed by the Bill to give the Council a general power, with certain limitations, to make subways in streets for the reception of pipes and wires, and for the construction of tramways in the subways. Copies of the Bill had been circulated among members, and the Committee recommended the Council to approve it, and to seal a petition for leave to bring in the Bill. This was agreed to.

The Highways Committee reported that the National Telephone Company had applied for consent to lay cables across Bayswater Road to join up the underground work in Paddington with that existing through Hyde Park, and to lay cables underground to enable the company to divert overhead wires, connecting with its old exchange in Battersea Park Road, to the new exchange in Lavender Hill. The company had submitted plans of the proposed works, and stated that the consent of the local authority had in each case been obtained, and that the Postmaster-General would raise no objection to the proposal. The Committee reported at length upon the matter, and having regard to all the circumstances, and especially to the facilities which the works would afford to the company's subscribers, the Committee were of opinion that consent might be granted, subject to the conditions laid down in the resolution of June, 1897, and a recommendation to this effect was carried.

Light Railway Legislation.—The President of the Board of Trade has appointed a committee, consisting of Sir Francis Hopwood, K.C.B., C.M.G. (chairman); Sir John Edward Dorington, M.P., chairman of the Gloucestershire County Council; Colonel Sir Herbert Jekyll, R.E., K.C.M.G.; Mr. Arthur Thring, Mr. Jeeves, Town Clerk of Leeds, Mr. Sydney Morse, and Mr. George White, to consider and report what additions or amendments to the Light Railways Bill, 1901, it would be desirable to propose, having regard to the provisions of the Tramways Act of 1870 and the Light Railways Act of 1896. Mr. P. H. Thomas has been appointed to be secretary to the committee.

Correction.—In our last week's issue we described an illustration on p. 1008 as "Prestwich Electricity Works"; we learn, however, from Mr. H. A. Wood, the electrical engineer-in-charge, that the plant referred to is part of the lighting and power station of the County Asylum, Prestwich, the largest of its kind in the kingdom, the installation consisting of 14,000 8-C.P. lamps and 140 H.P. in motors.

Lectures.—A paper was read on Wednesday last week by Mr. R. A. Chattock, the City electrical engineer, before the Engineering Society at the Bradford Municipal Technical College on the subject of "Coal and Ash Conveying Gear."

Towards the end of October, a meeting of the Queensland Electrical Association was held at Brisbane to hear and discuss a paper by Mr. E. C. Barton, M.I.E.E., on the subject of electricity applied to railways, and "more particulaly concerning the rival systems now struggling for supremacy on the underground railways in London."

The West Riding Technical Instruction Committee have arranged with Dr. J. A. Fleming to give, in March next, a course of four lectures on "Alternating Electric Currents."

Yorkshire College Engineering Society.—Mr. A. O. Allen, B.Sc., read a paper to the members of this Society on December 9th, taking for his subject "The Exact Measurement of Length." He stated that the most accurate measurement attained by engineers was not sufficiently accurate for the physicist, who was not content to measure to one-millionth of an inch; and proceeded to show how, by means of optical instruments, very much more exact measures had been obtained.

Electrical Industry and Legislation.—At a special meeting of members of the London Chamber of Commerce on Wednesday afternoon, Mr. R. Percy Sellon, chairman of the Electrical Trade Section, delivered an address on "The Electrical Industry and Legislation: the Need of Revision." Lord Avebury presided.

Municipal Contracts and Rates of Wages.—At the Bradford City Council last week there was a lengthy discussion on the question of Corporation contracts and rates of wages. The following resolution was passed by a majority, after several amendments had been lost:—"That it be an instruction to the several committees having contract works in hand to take immediate steps to ascertain what rate or rates of wages are being paid at the present time by the several contractors concerned to the workmen engaged on such Corporation contracts, and, if in any case or cases it be found that such contractors are now paying a less rate or rates of wages than the standard rate of wages which obtained in the several trades at the dates when their respective contracts were signed, that notice be given to the contractors in question, requiring them to pay the said standard rate of wages, failing which, the penalty clauses of the respective contracts shall be enforced forthwith."

Obituary.—It is with deep feelings of regret that we have to record the death of a widely esteemed veteran of the submarine telegraph cable industry—we mean Mr. Matthew Gray, of the India-Rubber, Gutta-Percha and Telegraph Works Company, Limited, of Silvertown. This gentleman passed away on Monday last, 16th inst., at the ripe age of 81 years, at his residence in Abbey Wood, Kent, and his loss is greatly deplored by all who have known him during his very lengthy identification with the company mentioned. There was something of a gloom over the meeting of the company held on Tuesday last, and the expressions of sympathy with the relatives of the deceased gentleman were but an indication of the genuine and deeper feelings which were being experienced by those who added their tribute to the memory of Mr. Gray, and to their appreciation of his sterling qualities as a business man and as a gentleman. We, personally, as representatives of the great electrical fraternity, join cordially in these expressions of condolence with the affectionate daughter and sons who have lost so worthy a father. The funeral ceremony is to take place to-day at East Wickham at 12.15 p.m.

Appointments Vacant.—Assistant engineer for Oldham electricity works at £100 per annum; a demand note clerk and collector (£100 to £150) is wanted for Stepney electricity department; a chief electrical and tramway engineer is wanted by the South Lancashire Electric Traction and Power Company, Limited, at £500 per annum.

Personal.—Mr. Henry Nichol Thomas, at present electrical engineer, was appointed general manager of the Huddersfield Corporation tramways on Wednesday, 18th.

THE CENTRAL STATION ENGINEER.

Mr. Douglas Kelleway, of the Isle of Thanet Electric Tramways and Lighting Company has been appointed electrician-in-charge to the Folkestone Electricity Supply Company.

Mr. T. Partington has been appointed engineer, and Mr. J. B. Robb, assistant engineer at Pemberton electric lighting station.

The annual festive gathering of the employés of the Sheffield Corporation tramways was held on Friday evening. Mr. A. L. C. Fell, the general manager, presided, and expressed pleasure at the attendance of so many members of the Tramways Committee. In responding to the toast of "The Committee," Councillor Wheatley gave some interesting statistics dealing with the department. In the six months ending September 29th last they carried over 25,000,000 passengers, and their receipts were over £99,000. Up to that date there had been a capital expenditure on the undertaking of £700,000, and the outlay was continually increasing. They paid in wages about £1,250 a week, and occupation was found in the construction of new lines and similar works for over 400 men, outside those directly employed by the Tramways Committee, while in bad weather they had sometimes employed as many as 750 additional men. They were working on money borrowed on the credit of the ratepayers, and therefore they had to see that the great undertaking paid its way, and, if, possible, made a little profit.

After five years' service at the Windsor Electrical Installation Company's works, Mr. J. W. Hawes has been appointed assistant engineer at the Bermondsey Council's electricity works. A farewell dinner was given in his honour at Windsor last week, and Mr. Hawes was made the recipient of an illuminated address, a cigarette holder, and silver cigarette case.

Mr. J. W. A. Binner, who has been at the Accrington Electrical Works during the past 12 months, has received an appointment as assistant electrical engineer of Bermondsey.

Mr. Edward B. Stiven, Dundee, has been appointed electrical engineer of Rothesay.

CITY NOTES.

Nernst Electric Light, Limited.

The report for the year ending September 30th, 1901, reads as follows:—"The expenditure during this period, after deducting interest on deposits, dividends, transfer fees, and receipts for the sale of lamps, is shown to have been £9,257 17s. Of this sum, £3,735 18s. 11d. is represented by assets, the remainder, £5,521 18s. 1d., being working expenses, which sum, as in the last balance-sheet, has been carried to development suspense account. No account has been taken of any royalties to which the company are entitled on lamps sold in Great Britain by the Allgemeine Elektricitäts Gesellschaft, of Berlin, during the period under report, the accounts relating to these not being due to the end of the year. After the adjourned meeting in the early part of the year, the directors, in accordance with the policy announced in their report, made arrangements for the manufacture in quantity of Nernst lamps in the form then exhibited, incorporating also further suggestions made to them at the time, and a considerable quantity were prepared for the market. Unfortunately the various reports received concerning the lamps issued experimentally in the company's territories, and further tests made in the company's laboratory, were not such as to justify the board in continuing the manufacture on an extended scale until certain imperfect features had been corrected. Although urged to make lamps on similar lines to those adopted abroad, your directors decided, after careful tests, that such lamps were not in advance of those made by this company, and the propriety of this decision has since been proved by the fact that the issue of the above foreign pattern has been suspended. Information as to the progress made by Nernst Concessionaire Companies in other countries showed that they had so far equally failed to produce commercially saleable lamps. Realising, therefore, that the heavy expenses of maintaining factories and a staff in readiness for the manufacture of the lamp would possibly absorb the remaining capital of the company before it reached a profit-making stage, your directors decided to reduce expenses to the greatest extent possible, consistent with the maintenance of a sufficient organisation to continue the development of the lamp, while being prepared to take immediate advantage of the production of commercially saleable lamps by their own staff or by any of the Nernst Concessionaire Companies abroad, whose facilities and resources exceed those of this company. In view of existing circumstances, the directors decided from that time to reduce their fees to one-quarter of the authorised sums, and they propose to continue to work on this reduced scale until such time as the production of the lamp in a commercially saleable form is an accomplished fact. Should they be unable to bring the company to a self-supporting condition, it is not their intention to claim these arrears. They believe that the foregoing policy of reduced expenditure, until success has been attained, will meet with the cordial approval of the shareholders. The tests of the recent models of Nernst lamps produced by the staff appear to be in advance of anything hitherto achieved by this company or others, and they are of opinion that many of the difficulties have been overcome, especially as regards the large lamps, to which their efforts, as also those of other licensees, have for some time been mainly directed. This is the more encouraging as these later lamps are made under improved processes, for which supplementary patents have been applied for by this company in Great Britain. Your directors having been advised that they are entitled to obtain a compulsory license to manufacture for use in Great Britain, decided to make application to the Board of Trade for such license. In the event of a successful issue, the company's field of operations will be increased by the inclusion of Great Britain. Your directors, who with their friends have a large stake in the company, desire in conclusion to assure shareholders that they have every faith in the ultimate success of the Nernst invention, in spite of the many unexpected difficulties which have been encountered, and they believe that by prudent management the company may yet enter upon a profitable career. The following letter from Mr. Swinburne as to the present position of the lamp will be of interest to the shareholders:—

The Chairman and Directors, The Nernst Electric Light, Limited, November 25th, 1901.

Gentlemen,

In reply to your inquiry, I consider that you have made good progress in the working out of the Nernst lamp. You have been seriously handicapped by the absence of co-operation of the other concerns who are developing the lamp. This has thrown more work on your staff and taxed your resources much more

seriously than was to be expected, and has increased the time necessary. All the same I consider the progress satisfactory, and that your staff has done very excellent work. The commercialisation of the invention is taking no longer than is to be expected in such a case, and the advance has been real. Though I may have agreed with your policy at the time, owing to the progress in the small lamp, I now think it was a mistake to attempt to begin putting the small lamp on the market, and from a technical point of view, I feel your present policy of return to the original lines of making large lamps is sound. The small lamp seemed to be practically completely developed, and there was justification in tackling the more difficult problem, having regard to the greater commercial value of its solution. The large lamp, to occupy the field above that of the incandescent, has almost nothing to compete with it, and has, as I stated at the formation of the company, an enormous opening.

Though longer experience is necessary before we can speak certainly, the present development of the large lamp looks entirely successful.

I have seen nothing yet to alter my original opinion as to the Nernst invention.

Yours faithfully,

(Signed) JAMES SWINBURNE.

The retiring directors are J. G. Dalzell and Hugo Hirst, who offer themselves for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., retire, and being eligible, offer themselves for re-election."

Mr. Bernard Drake presided at the annual meeting of the company on Monday last at Westminster Palace Hotel.

In moving the adoption of the report to September 30th, 1901, the Chairman said that the balance-sheet showed that the share capital stands as before, with the exception of 120 preference shares, which have been forfeited on account of unpaid calls. On the credit side there was an addition of £448 on the purchase consideration, which was for the maintenance of patents in the company's territories, and also duties on new patents which had been taken out during the year. Additions in the shape of plant, tools, apparatus and materials had been made to the laboratory and factories, and a further addition to the electric light and power installation of about £300. The directors' fees were less than the amount authorised by the articles of association, as before the close of the financial year, in September, the directors had commenced to draw reduced fees. The report showed what they had in hand at the end of the financial year, and the directors trusted that before the balance was exhausted the company would have turned the corner, and be earning profits. In April last, Sir Henry Mance, the late chairman, acting under medical advice, was, unfortunately, compelled to vacate the chair, and, at the unanimous request of the directors, Mr. Drake agreed to accept that somewhat onerous position; at the same time the post of managing director was abolished, and Mr. G. S. Ram, a well-known authority on incandescent lamps, was appointed manager. Mr. R. P. Sellon and Mr. Hugo Hirst joined the directorate at the instance of an influential section of the shareholders and the cordial invitation of the board. Although Mr. Sellon's increasing engagements rendered it impossible for him to continue to give the necessary time to this company, and he therefore retired, Mr. Hugo Hirst, though equally busy, had agreed to continue to act for the present, provided he received the support of the shareholders, which the board had no doubt would be accorded. He would ask them kindly to bear in mind that although the period under review dated from September 30th last year, it was not until the adjourned meeting on January 16th that a future course could be decided upon; thus there had only been eight working months for the further development of the lamp. As any alteration required a period of about two months before it was possible to say whether it was an improvement or not, they would appreciate that with an invention of this class progress by leaps and bounds could not be expected, especially in view of the fact to which Mr. Swinburne had drawn attention, that they were compelled to rely mainly on their own individual efforts. The balance-sheet naturally dealt with the results as a whole, but it might be mentioned that a large proportion of the expense was incurred in the early part of the year in the attempt to manufacture for the market in quantity, and the utmost economy had been exercised since it became evident that this action was premature, and that it would be necessary to revert for a time to an experimental basis. Had others succeeded where they had failed, even though their resources were so much greater than this company's, it might have been urged that there was some possible cause for dissatisfaction, but they had assured themselves by careful inquiries in all parts of the world that the same difficulties were being encountered by all licensees; in fact, the Nernst lamp, although one of the most attractive electrical inventions, had proved a veritable "Will o' the Wisp," no sooner was it grasped than it escaped once more, necessitating a further weary search in untrodden fields. At this stage the directors decided to take into consultation representatives of several of the larger preference shareholders, and the subsequent policy to which reference is made in the report was forthwith adopted. He was quite aware that lamps had been shown at exhibitions, and shareholders in Germany might well have concluded that seeing lamps burning in Berlin, there must be something at fault if lamps were not being sold in this company's territories abroad. It must be remembered, however, that these lamps were in most instances supplied on a rental basis, and were all under the constant care of a powerful organisation, ready and willing to change them at a nominal cost to the consumer as often as might be necessary. It by no means followed that a lamp which was sufficiently developed for exploitation on this basis could equally well be sold outright for use in countries thousands of miles from the factory, where the lamps would be handled by less skilful engineers and the results obtained would not be known until months afterwards. During the year, however, a vast amount of information had been acquired, and with Prof. Nernst's cordial co-operation they should soon turn the corner. The recent report issued by the Allgemeine Gesellschaft, of Berlin, referred to the disappointments and enormous difficulties which they had encountered, although he was pleased to note that they had not lost faith in the ultimate success of the invention, and, like this company, they had recently made improvements which they anticipated would result in success. Until this company felt justified in issuing their own products, he was pleased to say that they had come to an amicable working arrangement with the Allgemeine Gesellschaft, of Berlin, whereby they could avail themselves on a profitable basis of their productions, as a result of which orders had been, or were being, executed for about 4,000 lamps for use in this company's districts representing a cash value of some £3,000. Shareholders must bear in mind that a large company dealing with concessions which involved the sale of heavy electrical machinery could easily afford to include the Nernst lamps at a price which would not be remunerative to a concern like the Nernst Company, depending solely on the Nernst lamp for its dividends. To one the Nernst lamp was merely an attractive feature of a complete system; to the other it was the sole means of existence. They would see exhibited in that room the large lamp for street lighting which had been designed by themselves, and made by them, and the results appeared to be sufficiently encouraging to warrant a gradual issue. After the past experience, however, he would ask the shareholders not to attempt to force the hands of the board in this direction, as they might rely upon it that they were all more than anxious to see this concern, with which their names had been publicly connected, brought to a dividend-earning stage, and would leave no stone unturned to achieve this end as quickly as possible. With regard to the application for a compulsory licence to make and sell lamps under their own patents in Great Britain, this step was only taken after the most careful deliberation and consultation with leading shareholders. If they succeeded, it would not only enable them to bring into operation a number of patents they had taken out in Great Britain which were now lying stagnant, but it would also enable them to manufacture in England for use in their countries such parts of the lamp as were covered by the original patent, thus avoiding the necessity for divided factories, which must be a source of additional expense and danger in a new enterprise. It would further enable them to render more productive the 10 per cent. royalty on lamps sold in England which they purchased from Prof. Nernst after the formation of the company. Although the energies of the staff have recently been mainly devoted to the large lamp which could be manufactured without necessitating the same degree of skill in manipulation, shareholders must not think that they had abandoned the problem of the small lamp. It was his (Mr. Drake's) personal opinion that a good deal of their trouble had been due to the attempt to get too high an efficiency in the first instance. Finding that lamps could be made to work at considerably below 2 watts per candle, they had struggled to keep their efficiency up to this standard, whereas they now found that if they were content at first with about 2 watts per candle, which was still half the energy required by the ordinary incandescent lamp in actual practice, a number of their difficulties became less acute. The recent development of an electrical furnace on entirely new lines, which was necessary before they could bake the large filaments, had also materially assisted them in the production of those of smaller size. Some curves of candle-power recently obtained were displayed on the wall, and he thought that they would be admitted to compare very favourably with the constancy obtained with the ordinary glow lamp. For the ordinary carbon vacuum lamp, as generally used, 16 c.p. started at about 13 or 14, and after 800 hours it fell to 8·8. The Nernst started at 20 c.p., and after 800 hours had only gone down to 16·5. There was thus a considerably less drop in candle-power than with the ordinary lamp. Whether those results could be regularly attained on a large scale, time and experience alone could prove, but he had every hope that next year he would have a better record to submit.

Mr. Hugo Hirst seconded the resolution, which was carried unanimously.

The retiring directors and auditors having been re-elected, the proceedings terminated.

India-Rubber, Gutta-Percha and Telegraph Works Company.

The annual meeting was held at Cannon Street Hotel on Tuesday, the Hon. Henry Marsham presiding.

In moving the adoption of the report, the Chairman said that it did not call for much comment, as the financial year had been, so far as the business was concerned, of a normal character. At the half-yearly meeting which was held early in June, he had not the advantage of being present, as he was absent on a mission in connection with the company's affairs which might in the future prove of benefit. Major Darwin, who presided, stated that up to the period of that meeting the general business did not show the same turnover as that of the corresponding period of the previous year. He added, however, that an improvement was observable. He (the chairman) was glad to say that this improvement continued until the end of the financial year, and at the closing of the company's books the total of the trading was only slightly lower than for the previous year. The profit, unfortunately, had not been so large, although the board felt that they had no great reason to complain at the result. The always increasing competition in the different lines of manufacture in which the company was engaged, called for the adoption of the best existing machinery and conveniences, and the works at Silvertown and Persan were continually undergoing alteration in plant and accommodation. The board hoped that by thus keeping abreast of the times the company would maintain the reputation it enjoyed for the excellence of its manufacture. At the half-yearly meeting they reported that their cable

steamers *Silvertown* and *Buccaneer* had been employed early in the year, and he had now to state that the *Dacia* was on the point of returning home after a three months charter to the Spanish Government and to the Western Telegraph Company, and that on her return she would immediately proceed to sea on charter to the Western Telegraph Company to lay a cable of about 500 nautical miles, of which they had recently completed the manufacture. They had just commenced the manufacture of 2,400 nautical miles of cable for the Commercial Pacific Cable Company. This cable would also be laid by them. The board tendered for this work at an extremely low figure in order to secure the contract. He had an object in giving them this information, as he did not wish them to go away with an impression that the work might prove highly remunerative. As they were aware, one could not, in this class of work, which entailed considerable risk through unforeseen misfortune from weather or from other causes, predict results from a financial point of view. They might rest assured, however, that nothing would be wanting in the skill and foresight brought to bear for the successful accomplishment of the work, and they hoped that when the cable was laid between San Francisco and Honolulu, in the Sandwich Islands, that extensions of the line would be determined upon, and that a portion of the work would fall to their share.

The motion was seconded by Mr. Abraham Scott, and carried unanimously. The retiring directors and auditors were re-elected.

In connection with the vote of thanks to the board, the death of Mr. Mathew Gray, which occurred on the 16th ult., was referred to. Mr. Silver and shareholders' representatives dwelt in very high terms upon the sterling qualities of this remarkable man. Mr. Silver said that, in the course of his 65 years' experience in London, he had never met Mr. Gray's equal in ability and resolution. A vote of condolence with the relatives of the late gentleman was coupled with the vote of thanks to the directors, and Mr. R. Kaye Gray thanked the meeting on behalf of the family for their kind expressions of sympathy.

Douglas Southern Electric Tramways, Limited.

The annual meeting was held in Manchester on 18th inst., Mr. Thomas J. Hutchinson presiding. The directors reported that the company's season had consisted of 130 days, against 121 last season, and the mileage had been 34,277, as against 34,033 last season. The gross earnings during the season yielded £5,026 3s. 3d., as against £4,583 3s. 11d. last season, or an increase of £442 19s. 4d. The net profit for the season was £2,042 11s. 10d., as against £1,617 14s. 9d. last season, and this added to the £355 3s. 5d. carried forward on October 31st, 1900, gave a disposable balance of £2,397 15s. 3d.; and the directors for the first time had the opportunity of recommending the full dividend of 7 per cent. per annum on the preference shares, but also that 2½ per cent. per annum be paid upon the ordinary shares. There would also be a balance of £220 17s. to be carried forward. The permanent way, engines, boilers, electrical equipment, buildings, and rolling stock had been thoroughly overhauled and maintained in a high state of efficiency out of revenue.

Typewriting Telegraph Corporation.

The second ordinary general meeting of this company was held last week at Winchester House under the presidency of Sir James Fergusson, M.P., who said that he was invited as a director of the National Telephone Company, which, with the Post Office authorities, had adopted the instrument then in use, and he thought that it was only a part of the same business as that in which he was interested. As time went on, however, difficulties revealed themselves. The first trouble which came upon the company was a notification from the Post Office that they did not find the instrument entirely satisfactory, and that it required some alterations in its structure. Steps were taken to comply as quickly as possible with the wishes of the Post Office, but it was not until June 6th last that the agreement with the department was signed. Fresh obstacles to the progress of the business were met with on account of the contractors getting seriously into arrears with their deliveries. A contract was made for 450 instruments to be supplied at the rate of 10 weekly, but the undertaking was never fulfilled. Other arrangements had since been made for the manufacture of the instruments, and no doubt the company would in time be able to obtain adequate deliveries. Within a short time it would be possible to get them from abroad at a lower rate than the board had covenanted to pay in this country. Having alluded to the way in which the business had been handicapped, owing to the illness and death of the late manager, he stated, says the *Times* report, that negotiations had been going on for the sale of the company's patents in the United States, France, Germany, Scandinavia, Belgium, Russia, and South Africa. Options had been granted on five of these patents, and the directors trusted that completion of purchase would follow. Steps had been taken to make the burden of management as light to the shareholders as possible. The directors had not drawn any fees. He believed that the company had surmounted their initial difficulties, and that if proper exertions were put forth and they could get delivery of the instruments, there was no reason why the invention should not be made to yield satisfactory results. He was aware that there was a strong movement of opposition against the board. The gentlemen at the head of that movement had met the directors and had been given the fullest information. When asked if they could suggest anything which the board could do they had nothing to advise, so he thought that they must have recognised that the difficulties which had been faced could not have been avoided. Had he consulted his own convenience he should long ago have resigned, but, having joined the board, and feeling that there might be some shareholders who had subscribed to the capital on the strength of his name, he had deemed it his duty to stay on. The accounts showed a receipt of merely a few hundred pounds, and a deficit of £3,761. But the expenses were from the inception of the company, and during the period when the business was practically at a standstill, and therefore they were larger than they otherwise would have been.

The adoption of the report was seconded by Mr. C. E. Spagnoletti.

A discussion followed, in the course of which considerable dissatisfaction was expressed at the way in which the business had been managed; and an amendment to the effect that a committee should be appointed to inquire into the conduct of the company's affairs from the start was agreed to after the chairman had said that the board had no objection to the appointment of a committee. The meeting was afterwards adjourned till the 9th prox.

Automatic Telephone Company.

The annual meeting of this company, held at Cannon Street Hotel on Thursday last week, was presided over by Mr. Bernard Parker, who said that notwithstanding all the vicissitudes which the company had met with during the last four years, they had not lost faith or hope in the future of the undertaking. After years of waiting Mr. Seligmann Lui had at last completed the working model of his invention. He (the speaker) had had an opportunity, in company with a co-director, Mr. Gibbes, of seeing it at work in Paris, and he formed a very favourable opinion as to the utility, practicability, and (from a commercial point of view) the necessity of the invention. He did not wish to be over sanguine as to the future, because he recognised the difficulties that had to be met with in establishing the commercial utility and advantages of any new invention. In the course of a very few months, however, they ought to be in a position to prove to the telephone experts of the Post Office, the London County Council, and the National Telephone Company that, by adopting this invention, they could reduce the charge to subscribers very considerably and yet make a much larger profit than is made under the system just started. Having reviewed the history of the company, and the litigation which arose between the old board and Mr. Seligmann Lui, the chairman said that under the re-organised board a reasonable arrangement had been made with Mr. Seligmann Lui, whereby he was to receive £500 on account of arrears of salary and nothing more until he had completed his model and delivered it in London in proper working order. He was then to be paid the full arrears of salary up to the date of delivery, and the salary was to continue and to be paid quarterly up to the expiration of the original five years for which he was appointed. The agreement was entered into in April, 1900. Although the shares were widely distributed, they were, in effect, a parent syndicate, with a capital of £100,000, of which sum £6,000 is still held in reserve. In addition, they had some £2,400 available in cash. Apart from the payment which would become due to Mr. Seligmann Lui when he delivered his model, very little, if any, further cash would be required. He anticipated that they would then be in a position to contract with a corporation or company to instal the system for a fixed sum, which would leave them a profit, they guaranteeing the working for a specified period. Such an arrangement would require a very small outlay on their part, and, when once they had shown the practicability in working and the saving in cost by adopting their invention, the future was assured. From offers received within the last few days, he had no doubt whatever that any further capital which they might require after the delivery of the model would be forthcoming on terms which would be satisfactory to the shareholders. The chairman moved the adoption of the report. Mr. Max Mabgowski seconded the motion, which, after some discussion, was unanimously passed.

Rand Central Electric Works.

The report of the directors, to be presented at the meeting to be held to-day, states that the delay in the presentation of accounts is attributable to the abnormal condition of affairs consequent upon the war. The same reasons that militated against the operations of the company during the latter part of 1899 apply to the year under review. Although the company's earnings have been more than sufficient to cover the current expenses, a loss of £7,453 is recorded on account of the amount written off for depreciation—namely, £10,112. The total revenue received amounted to £25,395, as compared with £50,674 for the previous year, and the working expenses to £32,847 17s. 8d., as against £49,834 11s. for 1899. The receipts for power supplied amount to £24,470 against £49,640, the falling off being accounted for by the fact that mining operations were brought to a standstill, thus causing a very restricted demand for power; the average monthly KW.-hours generated during the year 1899 amounted to 617,760, whereas for 1900 this fell off to 277,660 per month. The damage to the works occasioned by the Boer raid on January 20th last, has been so far repaired that the plant can be worked to the extent of three-fourths of its capacity, and it is anticipated that all damage will be made good in the near future. It is estimated that the cost of these repairs will not exceed £5,000. The company is now supplying power to several of the mines that have resumed working, and a contract is about to be completed with the Johannesburg Municipality for supplying the town with light, from which source a good revenue may be expected to accrue.

Electric and General Investment Company.—The directors have declared the following interim dividends. At the rate of 6 per cent. per annum on preference shares for the six months ending the 31st inst., being 3s. per share. 10 per cent. on the capital paid up on the ordinary shares, being 2s. per share for the six months ended the 30th ult. Both dividends will be paid, less income-tax, on January 1st, 1902.

Electric Railway.—A meeting of this company was convened for Wednesday at Winchester House, Old Broad Street, E.C., but a representative of the Electrical Review was refused admittance, being informed that no members of the Press would be allowed in.

British Electric Traction Company.—The directors have decided to pay an interim dividend at the rate of 6 per cent. per annum on the ordinary share capital for the half-year ended September 30th last.

The Brush Electrical Engineering Company.—The transfer books of the 4½ second debenture stock will be closed from December 19th to January 1st.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending Dec. 13th were £450; corresponding week last year, £432; increase, £18. Total to date, £25,093; corresponding period last year, £22,293, increase, £2,800. Miles of track open, 8¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending December 14th were £135; corresponding week last year, £147; decrease, £12. Total receipts to date, £20,649; corresponding period last year, £19,999; increase, £650.

Bristol Tramways and Carriage Company.—The receipts for the week ending December 13th were £3,717; corresponding period last year (electric traction introduced), £3,579; increase, £138.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending December 6th :—

Company.	Amount £	Comparison with corresponding week of last year. + £	Comparison with corresponding week of last year. − £	No. of weeks.	Aggregate. Amount. £	Aggregate. Inc. or Dec. + £	Aggregate. Inc. or Dec. − £
Croydon*	502	259	—	49	16,417	2,016	—
Devonport ..	383	—	—	24	9,490	—	—
Dudley—Stourbridge	634	139	—	49	32,210	16,048	—
Gateshead ..	614	—	—	30½	17,983	—	—
Greenock-Pt. Glasgow	360	—	—	9	2,469	—	—
Hartlepool	179	—	9	49	11,038	1,292	—
Kidderminster ..	91	4	—	49	5,932	686	—
Merthyr	180	—	—	35	8,737	—	—
Oldham—Ashton ..	489	—	24	49	24,335	3,140	—
Poole	180	—	—	95	9,897	—	—
Potteries	1,982	159	—	49	68,499	19,518	—
Southport†	110	—	5	49	7,944	—	2,794
South Staffordshire‡	782	112	—	49	37,891	2,511	—
Swansea	396	20	—	49	21,492	4,275	—
Taunton	48	—	—	15½	1,261	—	—
Tynemouth	165	—	—	37	10,237	—	—
Wolverhampton Dist.	73	25	—	49	3,230	757	—

* Partly horse † Reconstructing. ‡ Partly steam.

City and South London Railway.—The receipts for the week ending Dec. 15th were £3,460; corresponding week last year, £1,874; increase, £1,586. Total from July 1st to date, £52,328; corresponding period last year, £39,650; increase, £12,678. Miles open, 6¼; corresponding period last year, 4¾.

Central London Railway.—The receipts for the week ending Dec. 14th were £6,858; corresponding week last year, £6,006; increase, £852. Total receipts from July 1st (24 weeks), £148,110. Miles open, 6.

Dover Corporation Tramways.—The receipts for the week ending December 16th were £167 19s. 10d.; corresponding week last year, £163 9s. 5½d.; increase, £4 10s. 4½d. Total to date, £10,795 9s. 6d.; corresponding period last year, £10,250 19s. 1½d.; increase, £544 10s. 4½d. Miles of track open, 3. Car miles run, 1901, 5,268; 1900, 4,958. Number of cars, 1901, 12; 1900, 11.

Dublin United Tramways Company.—The receipts for the week ending December 13th were as follows:—D.U.T. Co., electric cars, £3,285 6s. 4d.; D.S.D. Co., electric cars, £690 12s. 7d.; total, £3,975 18s. 11d.; corresponding period last year—D.U.T. Co., electric cars, £3,355 16s. 2d.; ditto, horse cars, £21 8s. 0d.; D.S.D. Co., electric cars, £794 2s. 6d.; total, £4,171 6s. 8d.; decrease, £195 7s. 9d.; aggregate to date, £111,612 10s. 9d.; aggregate to date last year, £110,658 14s. 7d.; increase, £953 16s. 2d. The mileage worked is 45 miles electrically, as against 43 miles electrically, and two miles by horses, for the corresponding period last year.

Liverpool Corporation Tramways.—Receipts for the fortnight ended November 3 th amounted to £17,295, as compared with £16,008 in the corresponding week last year, increase £1,286; 3,744,775 passengers were carried, against 3,348,068 in the corresponding period last year. 351 vehicles including six-horse vehicles are now in use.

Liverpool Overhead Railway.—The receipts for the week ending Dec. 14th were £1,336; corresponding week last year, £1,527; decrease, £191. Total from July 1st to date, £57,739; corresponding period last year, £59,658 decrease £1,919. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The money market, as a disquieting feature, can now be fairly dismissed from consideration for the present. New York appears to be in a somewhat uncertain condition, 10 per cent. having been paid for loans in some cases during the last week, but on this side of the water daily cash can be obtained for about 3½ per cent. For the next fortnight it may be taken that rates will be maintained—may, possibly, stiffen a fraction, but in no way sufficiently to affect Consols and the investment markets. The firmness of the Funds through the past ten days is due to bear covering, aided by purchases on behalf of Continental buyers. Its effect upon other departments has not been as marked as usual, and those markets with which we are particularly concerned sound no responsive echo to the advance in gilt-edged securities. In fact, the telegraph division is unmistakably flat, thanks to Signor Marconi. Electrical Supply stocks and shares are but little altered.

Now that the Board of Trade's decision with regard to the proper system for electrifying the Undergrounds is officially announced, speculation in Metropolitan and in District stocks is falling off. The former, after being up to 78½, is back again to 77, the price at which it stood when we wrote last week, but District has recovered to the round 30. Central London Ordinary is down a point, upon the threatened competition with which the company is menaced. Some there are who profess to think that the anticipated dividend of 4 per cent. on the Deferred will fail of realisation. City and South London is very steady, and it will interest a good many proprietors to hear that the last issued 5 per cent. Third Preference stock is negociable on the basis of 118 to 120. This is the emission that was privately made after the last meeting. We have heard of stock changing hands privately at 117 quite recently, but the security seems reasonably cheap at anything below 125.

The telegraph market, as mentioned above, is flat. In consequence of the so-called successful communication between the Lizard and Newfoundland with the Marconi instruments, a number of selling orders in Anglo-American companies are coming to the Stock Exchange. Sharp falls have occurred in the three Anglo-American stocks, and smaller ones in Direct United States and Submarine Cables Trust. Eastern Ordinary and Eastern Extension shares are also under the cloud, and 10s. has been knocked off Globe Telegraph and Trust Ordinary for the same reason, the Preference shedding a sympathetic 5s. We probed the market to see whether the fall were considered justifiable. The general opinion is that the depression and sales are bordering on the absurd, but, as one jobber said with a shrug of his shoulders, "It frightens the old ladies, and they all come tumbling over one another in their haste to sell." Naturally prices pale. Globe shares look tempting at their comparatively low level, and those who previously missed the opportunity of buying Eastern Ordinary at 140—the price at which 5 per cent. on the money can be obtained—have another chance of making the investment.

But although the General Telegraph market is flat, one or two exceptions relieve the list from absolute monotony. London Platino-Brazilian Debentures are the turn harder, and so are West India and Panama Debentures. West African Debentures and West Coast of America Debentures are both a point up. Western Telegraph Ordinary, allowing for the dividend reduction of 3s. per share, are about ⅜ lower. Marconi shares are 3¼, with a very limited market.

In the electricity supply list, the most notable feature is the recovery in Charing Cross and Strand shares, which are now quoted "*ex* rights." Considering the price at which the new shares were issued, it is thought that the Stock Exchange might more appropriately quote the old shares "*ex* wrongs." The Preference are ½ down. Abundant, far too abundant, evidence of the Charing Cross and City Company has made walking outside one side of the Stock Exchange a matter of mire and bad language for over a week past. Brompton and Kensington are up another 5s., climbing slowly to that twice-par value which was suggested as an appropriate bourne for them.

National Telephones are neglected, and the only quotable alteration is a decline in the Third Preference. The 4 per cent. Debenture stock remains steadily at 101½, and there is no stock on offer in the market.

British Electric Traction Ordinary at 14 are now *ex* the dividend of 6s. lately paid. London United Tramways Preference shares are steadily ⅞ premium, and the Debenture stock is about 2½ premium. Mention of the last reminds us that the Inland Revenue officials have just developed a new insanity with regard to the stamp duty payable on transfers of partly-paid stock or shares. Incredible as it may appear to anyone unacquainted with Somerset House officialdom, the Inland Revenue demands that a transfer of sale of £10 shares, for example, with only £2 10s. per share paid, should be assessed for stamp duty upon the full nominal amount of the share! Thus, a purchaser of 100 London United Preference at ⅞ premium, with £2 10s. paid up on each share, would be liable for stamp duty upon a value of £10 17. 6d. per share, making a difference of no less than four pounds. Needless to say, the Stock Exchange is up in arms against such a newly-found regulation, which would stop business in partly-paid shares, unless, as we anticipate, a way can be found to drive through the Act.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Shares. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation Dec. 11th.	Closing Quotations Dec. 18th.	Business done during week ended Dec. 18th, 1901. Highest.	Lowest
82,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —102	99 —102	100	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3¼— 4½	3½— 4½	...	...
119,700*l*	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	78 — 83	78 — 83	...	...
804,720	Anglo-American Telegraph	Stock	£3 9s.	73/6	3⅛%	52 — 55	50 — 53	52	50
3,097,640	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	98 —100	94 — 96	99	94½
3,097,640	Do. do. Deferred	Stock	18s. %	£1 7s.	5s.%	9 — 9½	8 — 8½	8½	8⅛
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	5 %	3½— 4	3½— 4	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	180 —190	180 —190	...	...
1,741,029*l*	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	101 —103	101 —103	101½	...
16,000	Cuba Telegraph	10	8 %	7 %	...	5 — 6	5 — 6	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	13½— 14½	13½— 14½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½— 9½	8½— 9½	...	...
30,000*l*	Do. do. 4½ % Debs.	50	...	...	...	100 —104 %	100 —104 %	...	..
60,710*l*	Direct United States Cable	20	3½%	3½%	3½%	10¾— 11¼	10½— 10¾	10 15/16	10¼
104,300*l*	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	140 —144	138 —142	143½	138
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	92 — 95	91 — 94	93⅜	...
1,432,268*l*	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	112½	112
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14 — 14½	13¾— 14¼	14⅜	13⅞
320,000*l*	Do. 4 % Deb. Stock	Stock	...	...	...	113 —118	113 —118	113½	...
300,000*l*	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	5¼%	...	100 —103	100 —103	...	...
200,000*l*	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103	100 —103	...	...
180,227	Globe Telegraph and Trust	10	5⅛%	5¼%	5¼%	11¼— 11⅜	10⅜— 11¼	11¼	10⅞
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14¾ — 15¼	14½ — 15	...	...
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	30 — 32	30 — 32	...	...
78,000*l*	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	40 — 44	40 — 44	...	...
100,000*l*	London Platino-Brasilian Telegraph, 6 % Debs.	100	...	...	...	102 —105	103 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½%	...	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	¾— 1	⅞— 1	...	..
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	3⅜— 3⅝	3½— 3¾	3½	3 5/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	..	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅜— 5	4⅝— 4⅞	4¾	4 1/16
2,000,000*l*	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	95 — 98	95 — 98	96¾	95
500,000*l*	Do. 4 % Deb. Stock Red.	100	...	...	4 %	100 — 103	100 —103	102½	101½
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	1/16— 1 1/16	5/16— 1 1/16	...	...
100,000*l*	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	125 —130	123 —128	...	...
58,000	United River Plate Telephone	5	6 %	7 %	...	5 — 5½	5 — 5½	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
179,947*l*	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
155,600	West African Telegraph, 5 % Debs....	100	...	...	...	99 —102	100 —103	102	..
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛ - ⅜	..	...
150,000*l*	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	100 —103	101 —104	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	7 %	14¼— 14¾	13½ — 14 xd	14⅜	13½
75,000*l*	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	104 —107	104 —107	.	...
348,777*l*	Do. do. 4 % Deb. Stock Red.	100	...	...	...	103 —106	103 —106	104½	...
88,321	West India and Panama Telegraph	10	2 %	⅝%	...	⅜— ⅝	⅜— ⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 6 xd	5 — 6	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3½ — 4½	3½— 4½	...	...
80,000*l*	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	101 —104	102 —105	104½	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	⅜ — ⅝	⅜— ⅝	...	...
100,000	Do. 4½ % 1st Deb. Stock, Prov. Certs.	100	...	...	...	97 —102	97 — 102	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	8¼— 8¾	8½— 9	8¾	...
20,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8¼— 8¾	8½— 8¾	8⅝	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	7½— 8½	8 — 9	8¾	8½
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼— 5¾	5 — 5½	5 7/16	5⅜
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	105 —107	103 —105 xd	104½	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5¾— 6¼	5¾— 6¼	5½	...
150,000*l*	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	0 %	9 — 10	9 — 10	9¼	9
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12 — 13	12 — 13	12¾	12 5/16
400,000*l*	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	122 —127	125	
200,000	Do. 4½ % 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	102 —105	102 —105	104¼	104
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	4 %	4 %	8½— 9½	8½— 9½	9	8¾
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	12 — 13	12 — 13	...	...
400,000*l*	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	105 —108	105 —108	106¾	106½
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	6 %	7 %	5½— 6	5½— 6	5⅞	...
20,000	Do. do. 6 % Cum. Pref.	..	...	...	...	5½— 6	5½— 6	5¾	5⅝
120,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	105 —108	105 —108	108	107
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 1⅝	1½— 1⅝	...	..
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	3½— 4½	3½— 4½	4	3¾
250,000*l*	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 —100	94 — 98 xd	...	..
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	13½— 14½	14 — 14½	14⅜	14
220,000*l*	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	113 —116	113 —116	...	...
250,000*l*	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 99	97 —100	99⅜	99
8,652	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15 — 16	15 — 16	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15½— 16½	15½— 16½	16	15⅜
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 9	8 — 9	...	...
150,000*l*	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	98 —101	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000*l*	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
109,518	Westminster Electric Supply, Ord.	5	12 %	13 %	10½%	11½— 12½	11½— 12½	12½	11⅜

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation Dec. 11th.	Closing Quotation Dec. 18th.	Business done week ended Dec. 18th, 1901. Highest	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	‡ 10	...	...	...	4½ — 5½	4½ — 5½	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	87 — 91	87 — 91	...	...
62,674	British Electric Traction	10	6 %	8 %	9 %	14 — 14⅝	13⅛ — 14½xd	14⅞	13 15/16
93,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 12½	12 — 12½	12 5/16	12⅛
600,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	122 —125	122 —125	123¾	122½
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	8 — 9	8 — 9	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5½ — 5¾	5½ — 5¾	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	...	8 %	¾ — 1	¾ — 1	...	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	...	6 %	1 1/16 — 1 1/16 xd	1 1/16 — 1 1/16	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 105,731	2	4 %	5⅛ %	5 %	1⅝ — 1⅝	1⅝ — 1⅝	...	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	1⅞ — 2⅛	1⅞ — 2⅛	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	102 —105	...	...
125,000*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	99 —102	99 —102	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	15½ — 16½	15½ — 16½	16 5/8	15¾
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5¾ — 6¼	5¾ — 6¼	...	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	112 —116	112 —116	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	...	107 —110	106 —109	...	...
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	...	105 —108	105 —108	108½	106½
440,100	Do. do. Def. do.	Stock	...	...	...	107 —110	107 —110	107¾	106½
855,000	City and South London Railway	Stock	2⅛ %	1⅞ %	1¼ %	64 — 66	64 — 66	64	63½
47,500	Do. do. Ord. shares Nos. 22,501 to 70,000	10	...	...	...	6 — 6¼	6 — 6½	6⅜	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½ %	8 %	3 — 3½	3 — 3½	3 5/16	3⅛
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	100 —105	100 —105	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	2½ %	⅛ — ⅜	⅛ — ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	2½ %	1½ — 2½	1½ — 2½	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	80 — 85	80 — 85	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	84 — 89	84 — 89	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1¾ — 2¼	1¾ — 2¼	...	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	7 %	...	...	2½ — 3	2½ — 3	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	98 —102	98 —102	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	10 — 10½	10 — 10½	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 —102	99 — 102	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	16½ — 17½	16½ — 17½	16⅞	...
35,000	Do. do. do. 4½ % Pref.	5	...	4½ %	4½ %	5½ — 6	5½ — 6	5 9/16	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	112 —116	112 —116	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	23 — 24	23 — 24	23⅛	23
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½ %	3¾ %	3¼ %	5⅞ — 6⅛	5⅛ — 5⅜	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	12 — 12½	11⅞ — 12⅛	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	...	15½ — 16½	15½ —16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	...	6 %	... — ...	19/- to 20/-	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½ %	38 — 42	38 — 42	40	39
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	104 —106	104 —106	...	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	8 %	12 %	12 %	10½ — 11½	10½ — 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	91 — 94	91 — 94	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance 2/—4/-
National Electric Free Wiring, 17/6 paid, ¼—¾.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16.
Do. do. Pref. (£10 pd.), 10⅛—10¾.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 4 per cent. (October 31st, 1901).

MARKET QUOTATIONS, Wednesday, December 18th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	82/-	82/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	89/-	89/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a „ „ „	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£22	£22	..
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8d.	8d.	..
a „ Caustic (75/80%)	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	120 -	135/-	15s. dec.
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£8	£8	..
a Bichromate, casks ..	per lb.	2½d.	2½d.	..
METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b „ Wire, in ton lots	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £125	£75 to £125	
c Brass (rolled metal 3" to 12") basis	per lb.	7½d.	7½d.	..
c Tube (brazed)	per lb.	9d.	9d.	..
c „ „ (solid drawn) ..	per lb.	8d.	8d.	..
c „ Wire, basis	per lb.	7½d.	7½d.	..
c Copper Tubes (brazed) ..	per lb.	9½d.	9½d.	..
c „ „ (solid drawn) ..	per lb.	10½d.	10½d.	..
g Copper Bars (best selected) ..	per ton	£71	£75	£4 dec.

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£71	£75	£4 dec.
g „ Rod	per ton	£71	£75	£4 dec.
c „ (Electrolytic) Bars ..	per ton	£80	£80	..
c „ „ Sheets ..	per ton	£88	£88	..
c „ „ Rod ..	per ton	£82	£82	..
c „ „ H.C. Wire	per lb.	9½d.	9½d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f „ Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	8/5 to 8/7	8/5 to 8/7	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	43/4	43/1	3d. inc.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i „ Wire, galvanised No. 8 ..	per ton	£10	£10	..
g Lead, English Ingot	per ton	£10 10 to £10 12 6	£10 17 6 to £11	7/6 dec.
g „ „ Sheet	per ton	£13 10	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 17 6	£8 17 6	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p „ rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ „ strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10½d. to 1/0½	10½d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40	From £15 to £40	..
i „ „ in bars		£58	£58	..
g Tin, block	per ton	£112 to £113	£115 to £116	£3 dec.
g „ foil	per lb.	1/6	1/6	..
n „ wire, Nos. 1 to 16	per lb.	1/7	1/7	..
p White Anti-friction Metals — "White Ant" brand	per ton	£35 to £65	£35 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j „ 6 lea. Flax	per lb.	5½d.	5½d.	..
j „ 8 ply 10 lbs. Russian ..	per lb.	4½d.	4½d.	..
j „ 16 lbs. Russian, single ..	per lb.	4½d.	4½d.	..
j „ 18/9 lbs. Jute rove	per ton	£10 2 6	£10 2 6	..
k Zinc, Sh's. (Vielle Montagne bnd.)	per ton	£22 10	£22 10	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakespeare, [Co., Ltd. h Messrs. Jackson & Till. i Messrs. Rolling & Lowe. j Messrs. Walter H. Lindley & Co.

Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd p The Phosphor Bronze Company, Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS.

A PERMEAMETER FOR TESTING THE MAGNETIC QUALITIES OF MATERIALS IN BULK.

By Charles V. Drysdale, D.Sc., Associate.

(*Abstract of Paper read November 28th*, 1901.)

The instruments devised for testing the magnetic qualities of materials are all open to the objection that they require specially-prepared specimens. Not only is the preparation of these troublesome, but it is very rarely that tests made on them are of practical value, as they cannot be prepared from the bulk of a casting or forging. The manufacturer requires an instrument to determine the magnetic quality of any casting or forging, before a large amount of time and expense have been spent in machining it.

A permeameter should, as far as possible, fulfil the following requirements:—

(*a*) It should be capable of testing specimens, either in the form of large or small castings or forgings, or in the form of rods or plates.

(*b*) The test should be rapidly effected.

(*c*) The apparatus should be self-contained and portable.

(*d*) The instruments should be direct reading, and the test should not require experimental skill.

(*e*) It should be capable of testing either the permeability, the retentivity, or the complete hysteresis cycle.

(*f*) It should be simple and strongly made, and should be capable of being easily checked or recalibrated if deranged. It should *not* depend on previously standardised specimens.

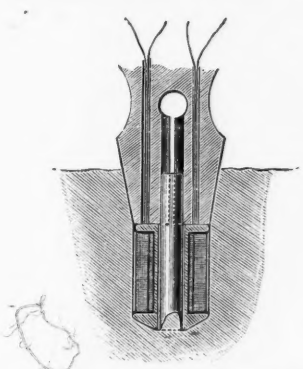


Fig. 1.—Section through Plug and Specimen.

The writer has adopted the plan in commercial testing of making both the specimen and the greater part of the return path from the bulk of the material tested. A drill of a special form is employed, which cuts a circular hole in the specimen, conical at the top, leaving a pin in the centre of it, as shown in fig. 1. In the instrument, as usually made, this hole is $\frac{3}{8}$ in. diameter, and $\frac{5}{8}$ in. deep, and the diameter of the pin is $\frac{1}{10}$ in., but these dimensions could be considerably reduced if necessary.

The testing arrangement consists of a soft iron plug, carrying a bobbin, on which are wound two circuits, a magnetising coil, and a search coil, shown in fig. 1. The plug is split, and is turned slightly

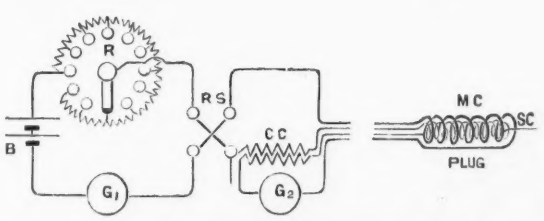


Fig. 2.—Connections for Ballistic Test.

conical on its outside surface, while the drill cuts the cone of the same angle as that of the plug. It will thus be seen that on drilling the hole and inserting the plug, a perfect miniature permeameter is produced, having an exceedingly good magnetic circuit, and in which either the permeability, retentivity, or hysteresis can be determined by ordinary methods.

There are very few castings or forgings in which a hole of the size mentioned would not be admissible, probably in the places reserved for bolt holes; but in the event of its not being allowable, there is no objection to a boss being left on the casting in any convenient position for the purpose of test, which could be cut off before drilling. For small castings, as above mentioned, it would be possible to reduce the drill and plug to half the dimensions above stated, if necessary. The time of drilling appears to be about 10 minutes in the case of cast-iron, and about 15 to 20 minutes in the case of wrought-iron, but this appears to be a small consideration in comparison with the importance of the information obtained, and it may be possible to reduce this time considerably.

Fig. 2 shows the connections which are most simply employed. The magnetising coil M C of the plug is supplied with current from a battery B, through a regulating resistance R and ammeter G, and a reversing switch R S. Connection is also made from the search coil S C to a ballistic galvanometer G_2. On making, breaking, and reversing the switch, deflections are obtained on the galvanometer G_2, which are proportional to the magnetisation of the specimen.

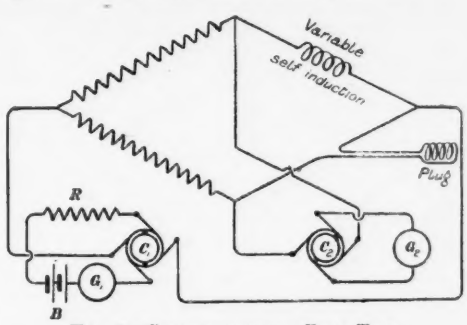


Fig. 3.—Connections for Zero Test.

In order to make the instruments direct reading it is easy to provide a scale for the galvanometer G_1 so that it reads the values of H. In the same way a scale is provided for G_2 reading the values of B directly. The permeability is then obtained, if necessary, by dividing the value of B by that of H; but it is generally sufficient to compare the values of B obtained with the curve of some satisfactory specimen.

In ordinary commercial testing of castings, &c., it would probably be sufficient to know the value of the permeability for one value of the magnetising force. In this case the arrangement may be further simplified by withdrawing the resistance R and galvanometer G, and simply arranging for the cells to give one definite current. The divisions on the galvanometer G_2 may then be marked directly with values of the permeability.

There are, of course, other methods of taking the observations, and two of them will be mentioned here, as different engineers may prefer different methods.

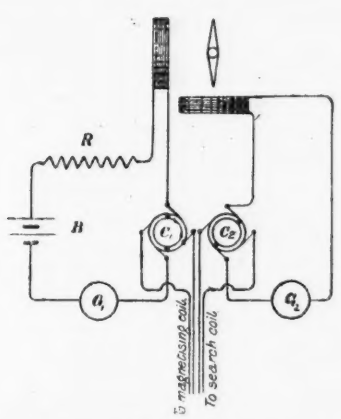


Fig. 4.—Connections for Direct Deflection Test.

Zero-Reading Method.—The determination of the permeability of the iron, of course, simply resolves itself into the determination of the self-induction of the magnetising coil. Fig. 3 shows a very sensitive method of effecting this, in which the magnetising coil is connected in one arm of a bridge, and an Ayrton-Perry variable standard of self-induction in the opposite arm. C_1 and C_2 are the two commutators of a secohmmeter, G_1 the galvanometer for measuring the values of H, while the galvanometer G_2 is simply a zero-reading instrument. The reading is then taken by rotating the secohmmeter and turning the inner coil of the variable self-induction standard till balance is obtained. The reading on this instrument can be made to give the permeability direct, while that of G_1 gives the value of H. The galvanometer G_1 must, of course, be calibrated with due regard to the fact that the current divides in the two halves of the bridge, and that the current is periodically interrupted by the secohmmeter.

Where an alternating supply is available, the secohmmeter may be dispensed with, and a telephone substituted for G_2. The alternating current might be supplied by a portable generator.

Direct Deflection Method.—For those who prefer to simply turn a handle and grind out a direct reading, which is apparently the highest ideal in an engineer's instrument, the connections may be made as in fig. 4. In this case a secohmmeter is again used, but it is connected so that one commutator reverses the magnetising circuit while the other reverses the search-coil circuit. The magnetising

and search coils are each connected with one of the coils of an ohmmeter, and a magnetic needle will then give a reading depending on the ratio of B to H, or the permeability direct, while the valves of H and B are separately given by the galvanometers G_1 and G_2. This method, like the last, has the advantage that only one winding is necessary in the plug; it makes, in fact, a simple universal method of measuring both resistance, and self and mutual induction. Provision must of course be made in this test for running the secohmmeter at a definite speed.

This might also possibly be employed with an alternating current of definite frequency by removing the secohmmeter and substituting a soft-iron needle in the ohmmeter.

Commercial Forms of the Apparatus.

Notwithstanding the attractions which the two latter methods offer, I have preferred up to the present to adhere to the simple

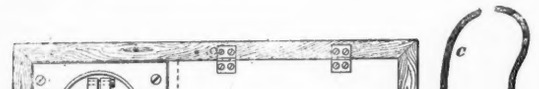


Fig. 5.—Permeability Testing Set.

ballistic test, as it requires only slightly more skill to read the ballistic throw, and the connections are more simple. Moreover, the handle-turning methods do not lend themselves well to determining the retentivity of the specimens or their B-H cycles, but simply give the mean B-H curve.

The apparatus is at present made in two forms—the simpler, which allows of the permeability and retentivity being directly read off; and the second, in which the magnetisation curve and the B-H cycle can also be obtained.

Fig. 5 shows the former of these arrangements. It consists simply of a wooden case 11 × 7½ × 11½ in. high, containing a battery of two large dry cells, a reversing key K, the plug P which is connected by a long quadruple flexible conductor C to the key K, and to a d'Arsonval ballistic galvanometer G, which is marked directly in values of the permeability. Space is provided under a flap for the plug and drills.

In order to obtain a test, all that is necessary is to drill the specimen, insert the plug and reverse the key. The pointer then swings to the value of the permeability, and if the circuit is then broken and twice the second reading taken from the first, the value of the retentivity is given.

(To be continued.)

CURRENT SPECIFICATIONS.

LXXXIV.—READING TRAMWAYS.

Summary.

Extent of Contract.—Contract No. 2. Supply and erection of the plant, works, machinery, and rolling stock for the proposed electric traction scheme.

Sub-division of Contract.—The specification is divided into various sections marked A to O.

Number and Type of Boilers.—To be of the horizontal water-tube type, with straight tubes. Three boilers to be fitted, each with not less than 2,000 sq. ft. heating surface. A number of technical particulars and guarantees to be given.

Superheaters.—To be fitted to each boiler, capable of imparting from 100° F. to 120° F. to the steam when working at normal load.

Mechanical Stokers.—Of the underfeed type, to be fitted to each boiler.

Fuel Economiser.—Of Messrs. Green's or other approved type, having 240 tubes. Scraper gear to be driven by an electric motor.

Feed Water Heater.—One to be provided capable of dealing with 2,000 lbs. of water per hour.

Feed Pump.—To be of the three-throw radial or other approved type. Three to be supplied, one to pump 1,500 gallons per hour, and each of the others 500 gallons per hour against a boiler pressure of 160 lbs. The larger pump to be driven by a steam engine, and the two smaller by an electric motor with double commutator.

Engines.—Four to be supplied, each of the two-crank vertica compound type. To be fitted with piston valves, and capable of giving as normal load 150 B.H.P. (100 KW.). To have 50 per cent. overload capacity when working condensing and 150 lbs. pressure; also to be capable of developing for short periods 200 B.H.P. when exhausting to atmosphere. Speed to be 420 revolutions per minute. An auxiliary engine of similar type capable of developing 37 B.H.P. is also to be supplied. Speed to be 500 revolutions per minute.

Surface Condensers.—Four to be supplied, each with cooling surface of 350 sq. ft. Temperature of circulating water assumed to be 68° F.

Air Pumps.—To be of Edwards type, one for every pair of condensers, each to be driven by an electric motor of the double commutator type.

Circulating Pumps.—Two centrifugal pumps, electrically-driven, to be supplied, each capable of passing 22,500 gallons of water per hour.

Dynamos.—To be multipolar compound-wound 500-volt machines, suitable for traction work. Four to be supplied and directly connected to above engines, running at 420 revolutions. Output of each dynamo 100 KW. One 25-KW. auxiliary, 500 revolutions 500 volts, to be likewise provided and connected to small engine.

Switchboard.—To be of usual traction type.

Station and Car Shed Lighting.—227 glow lamps, arranged in series of five on the 500-volt circuit, to be installed, together with 12 arc lamps.

Travelling Crane.—To carry 10 tons as normal working load, and be suitable for a span of 28 ft. 6 in.

Number of Cars.—30 to be supplied to seat 48 passengers, 22 inside and 26 outside, suitable for 4-ft. gauge.

General Design.—To be similar to design sent with specification.

Trucks.—To be of the four-wheel type, to meet specified requirements, suitable for gauge of 4 ft. and wheel base of 6 ft. 6 in.

Motors.—Two motors per car to be supplied, each of nominal 25 B.H.P., to comply with requirements set forth on curves sent with specification.

Controllers.—To be of the electric rheostatic type.

Trolleys.—To be of enclosed spring type.

Training of Men.—Any tenderer for the complete installation to tender for training 30 drivers and 30 conductors before terminating his work in carrying out the contract.

Specified Dates of Completion.—Periods varying from five to nine months from date of order, the period varying in different sections.

Penalty for Late Completion.—Sums varying up to £5 per day for the various sections, £2 per day per engine for the four main engines.

Specified Terms of Payment.—Monthly payments up to 80 per cent. of the value of work done, 10 per cent. on completion, 10 per cent. at the end of 12 months' period of maintenance.

Stipulations as to Removal of Foreman.—Acceptable, see comments.

Stipulations as to Wages Paid to Workmen.—None.

Amount of Sureties.—To be stated in tender.

Arbitration Proposals.—See comments below.

Consulting Engineers.—Messrs. John Bowen and I. E. Winslow.

Date for Receipt of Tenders.—December 28th, 1901.

This specification has been prepared by Mr. I. E. Winslow, well known in connection with traction work in this country, who has been retained by the Corporation as consulting electrical engineer, and Mr. John Bowen, the engineer and surveyor to the Corporation. It comprises the whole of the plant necessary for the equipment of a traction system with 30 cars, the building work, permanent way and overhead equipment being dealt with in separate specifications.

The character of the plant proposed may be gathered from the above summary. It will be noted what small units have been chosen, viz., 100 KW., and many engineers will consider that the size might have been increased with advantage.

There is, however, ample internal evidence that the specification has been prepared by a practical man, and we have little to criticise from the technical standpoint. The date of delivery given in the general conditions as nine months, presumably for every section, is modified by varying periods given in the various sections, the longer period being given only if the whole contract is let to one firm.

The same remark applies to the penalty for late completion of the various sections, the inclusive penalty in the case of one contractor undertaking the whole work, being £10 per day after the expiration of nine months from the signing of the contract. We think that the clause relating to the dismissal of workmen at the request of the engineer might with advantage be modified in the direction of requiring the engineer to state to the contractor the reason why he wishes the workman or foreman to be dismissed.

Tenderers will do well to note the large number of drawings required under the contract, and to make provision for their cost in the offer.

The payment clauses are satisfactory, and in reference to the arbitration proposals, we regret that these are not unlimited in operation. Points relating to the manner in which the work is to be carried out are to be decided by the engineers, while other matters, involving the question of finance amongst them, may, in case of disagreement with the decision of the engineers, be referred to the arbitration of an independent engineer appointed by the President of the Institution of Civil Engineers. We regret this reservation, and advise tenderers to ask for the modification of the clause as at present drafted, as it mars the otherwise impartial character of the general clauses.

SHALLOW UNDERGROUND TRAMWAYS.

LAST week we published an abstract of the report of Messrs. Baker and Rider to the L.C.C. In the addendum by Mr. J. Allen Baker, vice-chairman of the Highways Committee, that gentleman says:—

"In my opinion there are distinct advantages in favour of the shallow tramway as compared with the deep tube construction, especially when the construction and operation is undertaken by the municipal authority.

"1. The shallow construction may be used as a subway for water, gas, electric, &c., mains, as well as a tramway, thus affording a double advantage and yielding a double revenue.

"2. When the pipe services have been removed into their subways, the great annoyance and disadvantage now experienced by the tearing up of the streets by the companies would be over, as no work would require to be done on such streets, except repaving or repairing of the pavement.

"3. This double service would not only enable the municipal authorities to deal with the pipes and mains without loss to the ratepayers (which would be impossible otherwise), but should prove to be financially profitable.

"4. The shallow tramway should be less costly for construction than the deep tube, and as it would run so near the surface, and be provided with more frequent stations, is not only better ventilated and better lighted, but, being more accessible to the public, would receive greater patronage, especially by short-distance riders.

"5. The shallow tramway following the routes of the streets would avoid the running under any private property, thus preventing the possibility of objection being raised on account of vibration (and which would also be entirely prevented by its special construction).

"6. The service would be much more frequent than in the deep tube, thus avoiding any waiting for trains, and as the shallow tramway would be approached by steps from the streets (which would be 12 ft. to 14 ft. above the tramway platforms) the time taken to descend by the elevators to the deep tube would be saved, and also the expense of operating the elevators, which is an important item of working cost.

"7. As these underground tramways have proved to be a great financial success and a public benefit in reducing congested street traffic in such cities as Boston, Paris, and Buda-Pesth, it may be safely assumed that a like result would be experienced in London, where the population and the need are so much greater.

"8. The provision of these subways in connection with the Council's surface lines would greatly enhance the value and increase the earning power of the Council's tramway system in London, and the providing of a complete system of intercommunication would be of the greatest value in solving the housing problem.

"In comparing the two systems the only advantage that occurs to me as important, in favour of the deep tube, is the probable greater disturbance of the streets (under which the shallow lines are being laid) during construction, but with a little extra cost it is possible to carry out the work with comparatively little disturbance to the street traffic and business premises along the route.

"A decided advantage that both the 'underground tramway' and 'deep tube' share over the surface tramway (especially in the congested thoroughfares) is the greater speed that can be obtained, and the consequent amount of time that is saved to the passengers.

"That there is an urgent necessity to deal with the ever-increasing congestion of traffic in our London streets will be conceded by all who are familiar with their condition.

"The steady increase of street traffic in the central parts of London during the past few years has been most marked, the constant congestion in many places, especially during periods when the streets are 'torn up,' being an intolerable nuisance, and a great loss to those who have adjacent business premises, while the loss of time to the travelling public has been very great. Sir John Wolfe Barry has recently published a carefully prepared estimate of the money value of the time that is now lost owing to congested street traffic (without taking into account the tearing up of the streets) at four only of the busy centres in London, viz., Cheapside, the Strand, Piccadilly, and the Tottenham Court Road and Oxford Street junction, amounting to the enormous sum of £2,154,000 per annum. If all the congested centres were estimated on the same basis this sum could be multiplied many times. In addition to the money loss about 8,000 persons are injured and 150 killed annually in London through street accidents, these principally occurring where there is the greatest congestion.

"If, therefore, we are to cope with either our present or our future requirements and prevent our streets from becoming really impassable, it is, in my judgment, our duty to take up the subject at once, and seek from his Majesty's Government those additional powers and amendments to existing Acts of Parliament that will enable the Council, as the central authority, to carry out these improvements in the interests of the whole metropolis. I think these powers should include the following:—

"1. To constitute the Council the authority for the County of London for constructing subways in streets for the reception of pipes, wires, &c., and where desirable for electric traction and other purposes of locomotion.

"2. To enable the Council in any case (notwithstanding anything contained in Sec. 92 of the Lands Clauses Consolidation Act, 1845) to require the owners of properties to sell to the Council such portions only of such properties as the Council may require for the construction of said subways without the Council being obliged to purchase the whole or any greater portion of same, the Council paying for the portions required and making compensation for damage by severance.

"3. To enable the Council (for the purposes of the Act) to alter the position of water, gas, electric, telephone, hydraulic, &c., pipes belonging to any company, and to place the same in such subways as the Council may construct, and giving the Council powers to levy a reasonable rate of charge upon said companies for the use of such subways.

In view of the many schemes for "deep tube" railways that will be brought before Parliament at its next session, and the recommendation of the Joint Parliamentary Committtee of last session that the merits of the sub-tramways for London should have consideration before further schemes were sanctioned, it seems to me an imperative duty that the Council should suspend standing orders in order to give the usual notices and seek the necessary powers in the forthcoming session."

THE ARMSTRONG-ORLING SYSTEM OF WIRELESS TELEGRAPHY.

IN the ELECTRICAL REVIEW of November 1st we commented on the sensational accounts of this system which had appeared in the daily newspapers, and at the same time expressed our regret that we were unable to put before our readers the details of the apparatus by which these marvellous results were achieved. We are now in a position to partly satisfy the curiosity of our readers. Having received an invitation to send a representative to the City offices of the inventors, we accepted. Only the *receiver*, however, was explained; the *transmitter* apparently is reserved for a more distinguished *début* before the Royal Institution, or, failing that, some other learned society.

After some preliminary explanations from Mr. Armstrong, during which he disclaimed responsibility for some of the exaggerated statements of the imaginative and guileless representatives of our non-technical contemporaries, we were shown a model which illustrated the operation of the receiver. The actual form of the receiver was then explained by the help of drawings taken from a patent specification, some of which we reproduce.

From the explanations given by the inventors and their assistant we were not long in discovering that the "Armorl system" was no new departure in principle at least. It is, in fact, the oldest known system of wireless telegraphy—namely, telegraphy by earth currents, a system which scores of inventors have been working at since Morse first telegraphed across a canal at Washington in 1842 up to Preece's latest installation, started this year at Rathlin Island.

Very little progress was made in telegraphy by earth currents before the invention of the telephone. Morse, as has been said, telegraphed across a canal at Washington, in 1842, and Lindsay, a few years later, telegraphed across the Tay, a distance of three-quarters of a mile. The ordinary needle galvanometer was used as a receiver in these experiments; but, with the advent of the telephone, a much more sensitive receiver was placed in the hands of the experimenters with earth current telegraphy. Prof. Trowbridge, in America, in 1880, was one of the first to make experiments with a telephone. He was able to hear the ticking of a clock at a distance of one mile, but his base at one end was some miles in length, and at the other end 50 ft.; there was, apparently, nothing very remarkable in this feat. In 1894 Prof. Rathenau made a series of very careful experiments in Germany. He succeeded in telegraphing three miles in water, using the telephone as a receiver. He recommended that the iron disc of the telephone should be replaced by a metallic tongue tuned to the number of breaks in the transmitting apparatus. He pointed out that by using several current generators, each one producing a definite number of current impulses, a number of non-interfering messages might be sent through water to distant telephones, each constructed to respond to but one definite rate of vibration. Sir W. Preece has worked indefatigably at earth current telegraphy since 1882, and several of his installations have been in use for considerable periods for the transmission of Post Office telegrams between places not directly connected by wire. The bases used in the Preece system were generally some miles in length.

We have given this short sketch of the history of earth current telegraphy in order that our readers may get a fair idea of the advances, if any, made by Messrs. Armstrong and Orling.

We have not yet seen a demonstration with the complete Armstrong-Orling apparatus, but we are promised that at an early date. In the meantime we merely give the inventors' statements of the results obtained, as we understood them from a conversation with them at the interview.

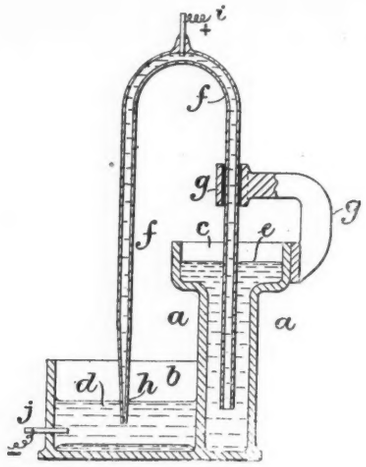


Fig. 1.

With base lines of about 30 ft., they have succeeded in telegraphing over a distance of five miles. The current passes from the transmitter to two metal stakes driven into the ground at the above distance apart, and the receiver is connected to two similar stakes. We understood them to say that their mercury relay, presently to be described, was used to operate an ordinary telegraphic receiving instrument such as the Morse. We gather also that speech had also been transmitted through the earth to considerable distances. Tuning is made use of to transmit non-interfering messages. This, as we have seen, had been suggested by Rathenau.

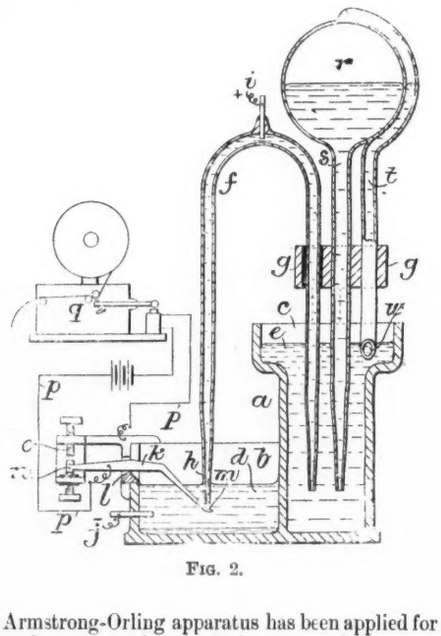


Fig. 2.

The Armstrong-Orling apparatus has been applied for other purposes than telegraphy or telephony. It has been used to steer torpedoes, turn on electric lamps, explode mines, &c.

The mercury relay designed by the inventors, and which they have named the "Armorl Electro-capillary Relay," is a very sensitive and simple apparatus, and appears to be well adapted for detecting the microscopic currents appearing at a distant station in earth telegraphy.

It is apparently an adaptation of Lippmann's electrometer.* In the Lippmann's electrometer the surface tension at the surface of contact between mercury and dilute acid is changed by passing an electric current across the surface of contact between the liquids. If the current passes from the mercury to the acid, the surface-tension is reduced, and if the initial surface-tension has just been sufficient to support a head of mercury in a capillary tube, the mercury will descend when the current passes. An exceedingly small E.M.F. will produce a perceptible change in the head of mercury supported; a thousandth part of a volt being approximately equivalent to a millimetre of mercury.

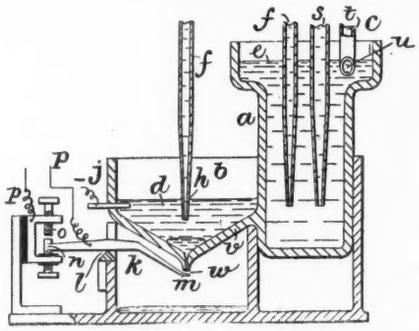


Fig. 3.

In the Armstrong-Orling mercury relay this phenomenon is utilised. Fig. 1 shows the simplest form of the invention. The vessel *a* is filled with mercury *e*. One end of a syphon *f* dips in the mercury *e*, and the other constricted end, *h*, into a vessel filled with dilute acid *d*. The siphon is supported by a bracket *g*, and is itself filled with mercury. The size of the constricted aperture is such that the surface tension, or capillary attraction, just prevents the mercury flowing out of the siphon. If the positive terminal of a battery is connected to the wire *i* passing through the walls of the siphon into the mercury, and the negative terminal to the wire *j* in contact with the acid, then a current will pass from the mercury to the acid. An exceedingly small current will be sufficient to cause the mercury to flow out of the siphon; the flow of mercury will stop immediately when the current is stopped. This arrangement is evidently adapted to act as a very delicate relay.

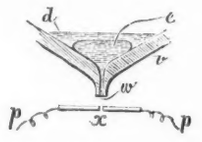


Fig. 4.

Fig. 2 shows a form of the relay adapted to operate a Morse receiving instrument. The mercury discharged from the syphon *f* by a weak electric current (such as earth currents), falls on the end of a lever *k*, fulcrummed on a knife edge *l*, and presses the outer end of the lever in contact with the stop *o*. This closes a local battery circuit *p* and operates the telegraph instrument *q*. The mercury in the vessel *a* is kept at a constant level by a reservoir *r* working on the principle of the bird fountain, *i.e.*, mercury is only discharged from *r* when air enters through the pipe *t*.

In fig. 3 another modification is shown. The bottom *v* of the acid vessel is funnel-shaped so that the mercury collects at the bottom, whence it flows through a small aperture *w* on to the end of the lever *k*. A still further elaboration of this idea is shown in fig. 4. Here the mercury flowing from the aperture *w* makes connection at *x* between two terminals *p p* of the local battery and instrument circuit. The lever *k* is thus dispensed with.

The instrument illustrated, fig. 5, is evidently based on Dewar's modification of the Lippmann electrometer. A bubble *d* of acidulated water is enclosed between two

* *Ann. de Chim et de Phys.* [5], Vol. v., p. 494; A.D. 1873.

columns of mercury 3, 3, in the tubular beam *y y* of a delicate balance suspended on a knife edge at *z*. A current is passed through the liquids enclosed in the beam from the terminals 6, 6. This causes the acid bubble to move to one side or the other according to the direction of the current, and disturbs the equilibrium of the balance. The insulated finger 7 makes contact with one or other of the stops 8 or 9, and closes either of two local circuits 10 or 11.

Such is the Armstrong-Orling mercury relay. We imagine it could be made an exceedingly sensitive receiver, more so even than the telephone, though of course that could only be settled by experiment. We should hardly

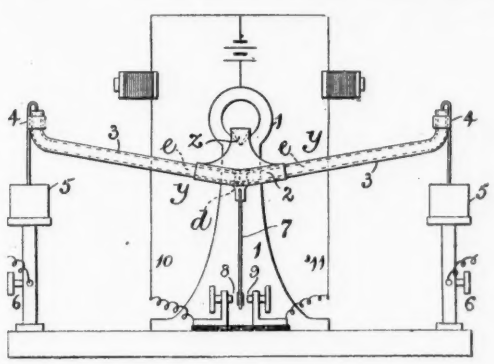


Fig. 5.

believe that it could be a conveniently portable instrument, and portability is put forward as a strong point in the "Armorl" system.

It is impossible to pronounce an opinion on the Armstrong-Orling system of wireless telegraphy as a whole, till we have fuller information. If the inventors have succeeded in telegraphing 5 miles with a 10 yards base at each end, by means of portable apparatus, they have made a considerable advance in earth current telegraphy. The range, however, is small, compared with the 300 miles odd achieved by Marconi; but circumstances might arise in which the 'Armorl" system would be useful.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

23,895. "Improvements in apparatus for electrically producing radiant heat." H. J. Dowsing. November 25th.

23,915. "A new or improved method and means for securing incandescent lampholders to service wires." W. R. Lambert. November 25th. (Complete.)

23,917. "Improvements in high tension insulating materials." C. Baur. November 25th.

23,934. "Improvements in and relating to automatic electric switches, indicating and recording devices and like apparatus." G. Charlton and W. E. Barton. November 25th.

23,990. "Improvements in poles for electric railways, electric lights and telephone and telegraph lines." November 26th. (Complete.)

24,011. "Improvements in electrical apparatus including telephone and like apparatus." P. M. Justice. (C. C. Barton, United States.) November 26th.

24,012. "Improvements in or relating to compound insulating material for electrical purposes." R. W. James. (The Mica Insulator Company, United States.) November 26th.

24,013. "Improvements in and relating to the control of the E.M.F. in electric circuits." H. W. Ravenshaw. November 26th.

24,052. "Improvements in globes or shades for incandescent electric lights." J. C. Fleming. November 26th. (Complete.)

24,054. "Improvements in resistances for arc lamps and other electrical apparatus." J. L. Davies. November 26th.

24,095. "Improvements in house service terminal boxes." S. W. Baynes. November 27th.

24,096. "A method of readily attaching or fixing the containing cases of electrical or other apparatus to telegraph, telephone and tramway poles or the like supports." M. Byng and F. G. Bell. November 27th.

24,109. "Improvements in suspension gas, oil or electric lamps and the like." P. Winn. November 27th.

24,137. "Improvements in gas and electric light pendants, brackets and stands." P. Thomas and C. J. Shaw. November 27th.

24,148. "Improvements in electrodes for arc lamps." A. D. Raine. (H. A. Macdonald, France.) November 27th.

24,149. "Improvements in cams for quick return movements especially applicable to electric igniters for explosion engines." M. J. P. O'Gorman. November 27th.

24,163. "Improvements in life saving fenders for electric tramway cars and the like." T. E. C. Wilson. November 28th.

24,169. "Improvements in and connected with the supporting standard and trolley arm used in overhead electric traction schemes." R. L. Ross. November 28th.

24,175. "Improvements in conduits for laying electric cables." H. N. Brooke. November 28th.

24,186. "Arrangement for decreasing and increasing the candle-power of an electric lamp." H. Frohman. November 28th.

24,192. "Protective mechanism for high tension systems of electrical distribution." E. de Pass. (R. V. Cheatham and J. S. Stewart, United States.) November 28th. (Complete.)

24,193. "Improvements in trolley wheels for overhead electric cars applicable to sheave and other grooved pulleys." H. W. Pinkerton. November 28th.

24,213. "Improvements in switches for use with lamp-posts for street lighting and the like." W. Sumner. November 28th.

24,215. "Improvements in electric transformers." C. Russo. November 28th.

24,239. "Improvements in cases or holders for Nernst lamps." B. M. Drake, E. G. Sheppard, G. S. Ram and The Nernst Electric Light, Limited. November 29th.

24,249. "Improvements in or appertaining to wooden or other like casing for electric wires." A. H. Marriner. November 29th.

24,254. "Improvements in and connected with telephone and telegraph communications." W. Foxton. November 29th.

24,276. "Improvements in or relating to electric arc lamps." The Jandus Arc Lamp and Electric Company, Limited, and A. D. Jones. November 29th

24,277. "Improvements in and relating to plates for electric storage batteries." C. S. Kaufmann. November 29th.

24,308. "Electrical distribution." J. L. Woodbridge. (Date applied for under Patents, &c., Act 1883, Sec. 103, March 13th, 1901, being date of application in United States.) November 29th.

24,316. "Apparatus for purifying water by electricity." J. S. Zerbe. November 29th.

24,327. Improvements in electric arc lamps." F. Procter. November 29th.

24,364. "Improvement in and relating to electric maximum demand or load indicators and recorders." D. J. Steele and C. Kratt. November 30th.

24,397. "Improvements in multiplex telegraphy using undulatory or alternating currents." W. P. Thompson. (La Société des Telegraphes Multiplex, Systeme E. Mercadier, France.) November 30th. (Complete.)

24,422. "Improvements in or connected with telephone systems." I. H. Parsons, of the firm of Gent & Co., T. Sloper and H. Snowdon. November 30th.

24,449. "Electrical apparatus." J. E. Everett. December 2nd. (Complete.)

24,457. "Improvements in method of and means for suspending overhead electric conductors." The British Thomson-Houston Company, Limited. (Union Electricität Gesel'schaft, Germany.) December 2nd.

24,470. "Improvements in electricity meters." C. D. Abel. (La Compagnie Anonyme Continentale pour la Fabrication des Compteur de Gaz et autres appareils, France.) December 2nd.

24,534. "Improvements in fenders for electrically-propelled cars." J. Durose and W. Tortoiseshell. December 3rd.

24,535. "An adjustable outside waterproof electric light fitting." H. J. Furniss. December 3rd.

24,552. "Improvements in dynamo-electric generators and motors." J. S. Herriot and H. Paterson. December 3rd.

24,557. "Improvements in fuse plugs for cut-out blocks." J. Sachs. December 3rd. (Complete.)

24,564. "Apparatus for electrically-operating and controlling the points, joint locks and signals of railways." A. H. Johnson. December 3rd.

24,582. "Improvements in and applicable to electrical fuseboards." A. Ford-Lloyd. December 3rd.

24,616. "Improvements relating to incandescent electric lamps." Societa Italiana di Elettricita gia Cruto. (Date applied for under Patents, &c., Act, 1883, Section 103, September 13th, 1901, being date of application in Italy.) December 3rd. (Complete.)

24,621. "Improvements relating to electric incandescent lamps." Societa Italiana di Elettricita gia Cruto. (Date applied for under Patents, &c., Act, 1883, Section 103, September 13th, 1901, being date of application in Italy.) December 3rd. (Complete.)

24,628. "Improvements in lanterns for electric or other lights." J. C. Fleming. December 3rd. (Complete.)

24,632. "Improvements in the field magnets of dynamo-electric machinery." C. E. L. Brown. December 3rd.

24,633. "Improvements in apparatus for use in driving dynamos on railway and other vehicles." F. J. Beaumont and W. M. Still. December 3rd.

24,666. "An improvement relating to an electric generator for use on motor car engines, gas and oil engines with speed gear for starting same." F. T. Reid and W. Shepherd. December 4th.

24,672. "Improvements in and connected with electric motors for driving spinning machines." H. Schonfeld. December 4th. (Complete.)

24,686. "Improvements in or relating to street lamp fittings for incandescent electric lamps." W. C. C. Hawtayne. December 4th.

24,695. "An improved tool for cutting the lead sheathing of electric conductors or the like." F. Tyers. December 4th.

24,713. "Combination of economy and choking coils for electric current." S. B. Griffith and F. Biliotti. December 4th.

24,737. "Improvements in or relating to electric batteries and lamps for use with same." M. Sutherland and E. Marcuson. December 5th.

24,760. "Improvements in or relating to electric incandescent lamp holders." W. Crookell. December 5th.

24,797. "Improvements relating to electrical motors." D. P. Burdon and E. F. Cavalier. December 5th.

24,803. "Improvements in controlling electric motors." The British Thomson-Houston Company, Limited. (H. W. Buck, United States.) December 5th.

24,804. "Improvements in switching apparatus for alternating electric currents." The British Thomson-Houston Company, Limited. (E. M. Hewlett, United States.) December 5th. (Complete.)

24,805. "Improvements in electrical measuring instruments." The British Thomson-Houston Company, Limited. (R. H. Read, United States.) December 5th. (Complete.)

24,806. "Improvements in electro-magnetic switches for electric railways." The British Thomson-Houston Company, Limited. (S. B. Stewart, jun., United States.) December 5th. (Complete.)

24,807. "Improvements in electric controllers." The British Thomson-Houston Company, Limited. (F. E. Case, United States.) December 5th. (Complete.)

24,808. "Improvements in coupling devices for electric conductors." The British Thomson-Houston Company, Limited. (F. E. Case, United States.) December 5th. (Complete.)

24,809. "Improvements in electric brakes." The British Thomson-Houston Company, Limited. (W. B. Potter, United States.) December 5th. (Complete.)

24,810. "Improvements in charging stations for electrically-propelled vehicles." The British Thomson-Houston Company, Limited. (C. E. Holmes and F. P. Cox, United States.) December 5th. (Complete.)

24,811. "Improvements in controllers for electric motors." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (L. A. Tirrill, United States.) December 5th. (Complete.)

24,812. "Improvements in electric railway systems." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (W. B. Potter, United States.) December 5th. (Complete.)

24,816. "Improvements in electric railways." C. J. KINTNER. (Date applied for under Patents, &c., Act, 1883, Sec. 103, May 6th, 1801, being date of application in United States.) December 5th. (Complete.)

24,828. "Improvements in surgical hand motors." A. W. DOWN and H. V. DOWN. December 5th. (Complete.)

24,839. "Improvements in and relating to telephone systems." P. ARNHEIM. December 5th.

24,863. "An improved method of actuating the carbon-feeding mechanism of electric arc lamps of the open and enclosed types." C. E. FOSTER. December 6th.

24,887. "A new and improved method of automatically and intermittently closing an electrical circuit which can be used in connection with railways." W. E. BURGESS. December 6th. (Complete.)

24,937. "Improvements in polyphase alternating current induction motors." W. LANGDON-DAVIES and A. SOAMES. December 6th.

24,987. "Improvements in or relating to a combined dynamo-electric machine, and a working cylinder and lubricating devices therefor, also otherwise applicable." A. J. BOULT. (N. A. Christensen, U.S.) December 7th. (Complete.)

24,989. "Improvements in telephone systems." D. MACADIE. December 7th.

24,992. "Improvements relating to electric primary cells or batteries." A. P. T. TULLY. December 7th.

25,004. "Improvements in printing telegraphs." J. MOORE and C. R. STELJES. December 7th.

25,008 "Improvements in electric relays." SIEMENS BROS. & Co., LIMITED, and A. GORDON. December 7th.

25,011. "Improvements in electrically insulatory wall plates and the like." H. J. HADDEN. (R. Müller, Germany.) December 7th.

25,014. "Improvements in preventing sparking when making and breaking electric circuits." A. B. RIGBY of the Electrical Transmission Company, and E. G. SCOTT. December 7th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1900.

1,356. "Improvements in the production of ozone." E. Andreoli. Dated January 22nd, 1900. For the production of ozone, the silent discharge of a low-tension current in the secondary circuit of a transformer is employed, together with a large condensing surface of thin glass sheets, so as to have less than 10 watts per square foot of dielectric surface. The ozoniser described in Specification No. 15,813, A.D. 1897, is preferably used.

1,445. "Improvements in electric transformers." A. H. Loring and H. L. Clark. Dated January 23rd, 1900. (Date applied for under Sec. 103 of Patents, &c., Act, 1883, June 24th, A.D. 1899.) Transformers constructed so as to be readily taken to pieces. The casing or box is adapted to be secured to a post or wall, and is provided with a sliding door for ready access. The core of the transformer is formed in two pieces, one preferably U-shaped, and the other secured, in order to close the magnetic circuit, by a bar, yoke, and screw clamp. The coils are suitably wound, and are adapted to slide on or off the limbs of the core when the second part is detached. Springs are fitted on the core to prevent vibration of the coils. The core is held in position in the box by means of a bracket having suitable lugs for the attaching screw.

1,450. "Push for electric bells or the like." T. Holme. (J. V. J. Silfverberg, Denmark.) Dated January 23rd, 1900. A strip of metal is pressed on to the two contacts by pressing in the flexible airtight cover.

1,457. "Improvements in and relating to electrolytic apparatus." W. Barnes. Dated January 23rd, 1900. The compartments of an electrolytic apparatus are placed in connection with a vacuum apparatus, whereby the gases evolved are withdrawn rapidly, and polarisation is prevented.

1,694. "Improvements in the treatment of carbon electrodes for electric arc lights." J. T. Robinson and J. H. Ferguson. Dated January 26th, 1900. A strong solution of caustic soda or potash is allowed to stand for some time over powdered Canadian asbestos, at either an ordinary or a boiling temperature. Ordinary carbon rods are soaked in the resulting solution for some days and then dried. The treatment increases the weight of the carbons about 10 per cent., and is stated to prolong their life, improve the quality of light produced, and effect economy in the pressure and power required to produce a given candle-power.

1,464. "Improvements in surface contact electric railway systems." J. M. Murphy. Dated January 23rd, 1900. Electric railways and tramways on a sectional conductor system with electro-magnetic switches. The circuit from the working sectional conductors to the feeder is made by a bridge-piece attached to a guided plunger which is lifted by a thin wire coil and held up by the outer thick wire coil in the main circuit. The thin wire coil is placed inside the thick wire coil and receives a shunt current from the sectional conductor to earth, but is cut out when the plunger is lifted by a stop thereon operating the switch arm. A spring is arranged to hold this switch arm in either open or closed position. The bridge piece carries carbon blocks and also a laminated spring contact which work against spring-mounted carbon blocks and fixed contacts. The laminated contact has stepped ends, so that each plate is pressed against the fixed contacts independently, and comes into action after the carbons and leaves before them, so that sparking only occurs at the carbon blocks.

1,475. "Improvements in electric igniters for explosion motors." J. Schiels and J. B. Boisselot. Dated January 23rd, 1900. The porcelain insulator of an electric igniter is protected from blows by a metal sheath, which may be perforated, and if the insulator should be broken the pieces are held in contact by a fixed conductor or a sliding one carried by an insulating sleeve. The invention is particularly applicable to motors for motor cars.

1,531. "Electric light dimmer." J. R. Hatmaker. Dated January 24th, 1900. A rheostat for reducing the light produced by an electric lamp; consists of a divided resistance and a switch under a cover which may be independent, or may be placed on the base of a bracket carrying the lamp.

1,555. "Improvements in the method of transmitting electric energy through ether and devices for same." E. G. Foresio. Dated January 24th, 1900. Relates to methods and means for transmitting energy through ether, without wires or along guiding wires, and utilising the transmitted energy for operating telegraphic or telephone instruments or electromotors. A source of electricity is placed in circuit with a coil and a spark gap. If the electromotive force is sufficient, a constant stream of sparks passes between spark gap, each spark causing a make and break of the circuit; the spark gap thus acts as a very rapidly operated switch. By properly proportioning the resistance, self-induction, and capacity each current can be made to rise slowly and fall rapidly, or the reverse. If the source is direct, the effect is to produce in the secondary of a coil or transformer intermittent currents in the same or opposite directions to that of the source. If the source is alternating, intermittent Hertzian currents are produced in the coil alternating with the source. The coil is in circuit with a line wire forming an open circuit with the primary of a transformer at the receiving station. Various arrangements are described which are too complicated for purposes of abridgment.

1,566. "Improvement in electric accumulator plates." H. Wuillot. Dated January 24th, 1900. Relates to thin accumulator plates, and consists in making a number of perforations in them so that the weight is decreased and the working surface remains the same or is increased, according as the sum of the areas of the peripheral surface of the holes is equal to or greater than the sum of the areas of the external surfaces of the pieces cut out.

1,573. "Improvements in or relating to rubber insulated electric cables." G. E. Heyl-Dia. Dated January 25th, 1900. Vulcanised rubber, in strip or sheet form, is employed for the inner sheathing of cables, and an outer sheathing is formed by applying unvulcanised rubber and then vulcanising it. The provisional specification states that this outer sheathing, or its vulcanisation, may be dispensed with.

1,583. "Improvements in or relating to the manufacture of electric cables." G. E. Heyl-Dia. Dated January 25th, 1900. The object is to produce by a continuous operation on a complete cable comprising several concentric conductors. The central conductors are led direct to the machine which applies the first coating of insulating paper or material, and then pass over rollers direct to the machines which alternately add further conductors and the layers of insulating material, and lastly, pass to the lead press supplying the outer covering. The machines are connected so as to act separately or collectively as desired, preferably by electric switches controlled by a switch on the press above mentioned.

1,617. "Improvements in or connected with carbon contacts for electric switches and the like." A. Reichwald. (F. Krupp, Germany.) Dated January 25th, 1900. A carbon contact for switches &c., is formed of a conical block of carbon secured in a holder by means of a collar bored to receive the carbon and screwing on to a base. A good contact is thus obtained.

1,618. "A new and improved method of regulating or controlling electric switches." W. Kingsland. Dated January 25th, 1900. Switches for making and breaking circuits, operated by tappet action, such as those used in sectional conductor systems of electric railways, are provided with brakes and stops to control their motion, and also in some cases to return them if they are moved past the proper point. The arrangements are applicable to tappet-actuated switches, and are shown as applied to cylinder switches with a star-wheel struck by a tappet.

1,680. "Improvements in picking up electric current sent from a generating station by a car and returning it." R. C. Sayer. Dated January 26th, 1900. Electric railways and tramways on a conduit system. Conduits, conductors, collectors.—The conduit consists of lengths of tubes closed at their ends by diaphragms and connected by fishplates lying between flanges on their sides. The supply conductors are supported in the lower part of the tube, and attached to studs projecting from the diaphragms between which connection is made by protected spring contacts. Couplings with valves which can be worked from outside are also placed between the diaphragms, so that the conduit may be kept filled with compressed air or any section cut out. The top of the conduit has a double set of teeth and valves which are depressed by plungers on the collecting wheel, and the valve spindles depress arms pivoted on the conductor whereby contacts are raised to complete the circuit to these plungers. These plungers are carried in boxes on the wheel which also has a double row of teeth, and these plungers and boxes are lowered over the valves and are held normally over them for a short time as the wheel revolves by sets of levers and links operated by two cam paths on the wheel. The return conductor is placed outside the conduit, and spring blocks carried by a conducting ring on the wheel work over it.

1,704. "An electric alarm." B. J. B. Mills. (D. Vial, France.) Dated January 26th, 1900. Consists of an electric contact-maker for burglar alarms, &c. The base, which is fixed to the door, &c., is provided with two terminals connected to the alarm circuit. The terminal plate has a pendulum suspended from it, the pendulum rod passing through the hole in the terminal plate. The rod is jointed or made wholly or partly flexible, and, normally, is not in contact with the plate. Any vibration of the door or other closure causes the pendulum to vibrate, so that the alarm circuit is completed between the rod and the plate. A protective casing is fixed over the mechanism by hooks, &c. The apparatus may replace the ordinary contact buttons or pushes of electric bells, in which case it may be operated by hand or otherwise.

1,813. "Improvements in filaments for electric incandescence lamps." H. H. Lake. (R. Arno, Milan, Italy.) Dated January 29th, 1900. Incandescent lamps. Filaments of the kind used in Nernst's lamps are made of any form symmetrical about a normal to the surface to be lighted and provided with as many connections as there are supply wires. The form preferred is a ring, with diametrically opposite connections for a two-wire system, or three equidistant connections for a three-phase three-wire system.

1,825. "Improvements in dynamo-electric machines." B. G. Lamme. (Date applied for under Sec. 103 of Patents, &c., Act, 1883, June 10th, A.D. 1899.) Dated January 29th, 1900. Armatures. In order to relieve, in alternating and direct current generators, unbalanced magnetic circuits due, for example, to wearing of bearings, defective castings, &c., the armature is provided with one or more additional windings, each closed upon itself and independent of the main generating windings. The closed circuit windings are arranged symmetrically about the armature, and are joined up at each end by rings. One or more other closed circuits may be also employed. By these means leading and lagging circuits in the closed windings are transmitted from one portion to another, thereby producing the balancing effect desired.

1,863. "Improvements in coils or helices for electrical purposes." W. G. Heys. (J. Scott, R. Varley, and J. C. Anderson, all of New Jersey, U.S.A.) Dated January 30th, 1900.

1,864. "Improvements in and relating to the method of winding coils or helices for electrical purposes." W. G. Heys. (J. Scott, R. Varley, and J. C. Anderson, all of New Jersey, U.S.A.) Dated January 30th, 1900.

1,886. "An improved arrangement of switching appliance for use with telephones." H. E. Newton. (P. Rabbidge, New South Wales.) Dated January 30th, 1900. Relates to direct-call systems, in which each subscriber is provided with a number of plug connections corresponding to all other subscribers.

1,906. "An improved electric pendulum clock." F. Haenohen and O. A. Haenichen. Dated January 30th, 1900. The hands are driven by a pendulum acting as a ratchet lever, and the energy of the pendulum is replenished electro-magnetically.

1,937. "Improvements in or connected with overhead collectors for electrically-propelled railway vehicles." R. J. Urquhart and H. Goodwin. Dated January 31st, 1900. Electric railways and tramways with overhead conductors.—The trolley wheel runs on an axis in the curved guard cradle, which is mounted on trunnions in the frame. Springs on the cradle bear on the frame to keep the wheel vertical, and preferably the trunnions are above the axis. The frame or fork swivels in the bearing place forward of the axis. The bearing is attached to the socket on the end of the pole by a knuckle joint, or by the bolt passing through the lugs, of which one is slotted with a curve slot struck from about the centre, so that the bearing for the fork may be adjusted so as to be vertical.

2,047. "Improvements in automatic electric switches or cut-outs." A. Eckstein and D. B. Mellis. Dated February 1st, 1900. Relates to electro-magnetic switches or cut-outs which are automatically opened should the current exceed, or fall below, certain limits, and which cannot be closed when the controlling circuit is too great, or when the current which would flow would be excessive.

2,077. "An improved accumulator battery." V. Cheval and J. Lindeman. Dated February 1st, 1900. One electrode is made up of a number of cylindrical or prismatic casings of insulated material perforated with a great number of small holes, and closed entirely at their lower ends. Each sheath is filled with materials to be rendered active, in the centre of which is a core of carbon or lead, which is connected to bars. Each of the casings is surrounded by a similar perforated sheath, which is attached at its upper and lower ends respectively to the edges of holes formed into horizontally-placed boards, which are held in place by four walls of insulating material. The material to constitute the other electrode is tacked between the sheets, and between them and the insulating walls, and is connected by conducting rods to bars.